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Tropical Hardwood from the Brazilian Amazon

A Study of the Timber Industry in Western Pará

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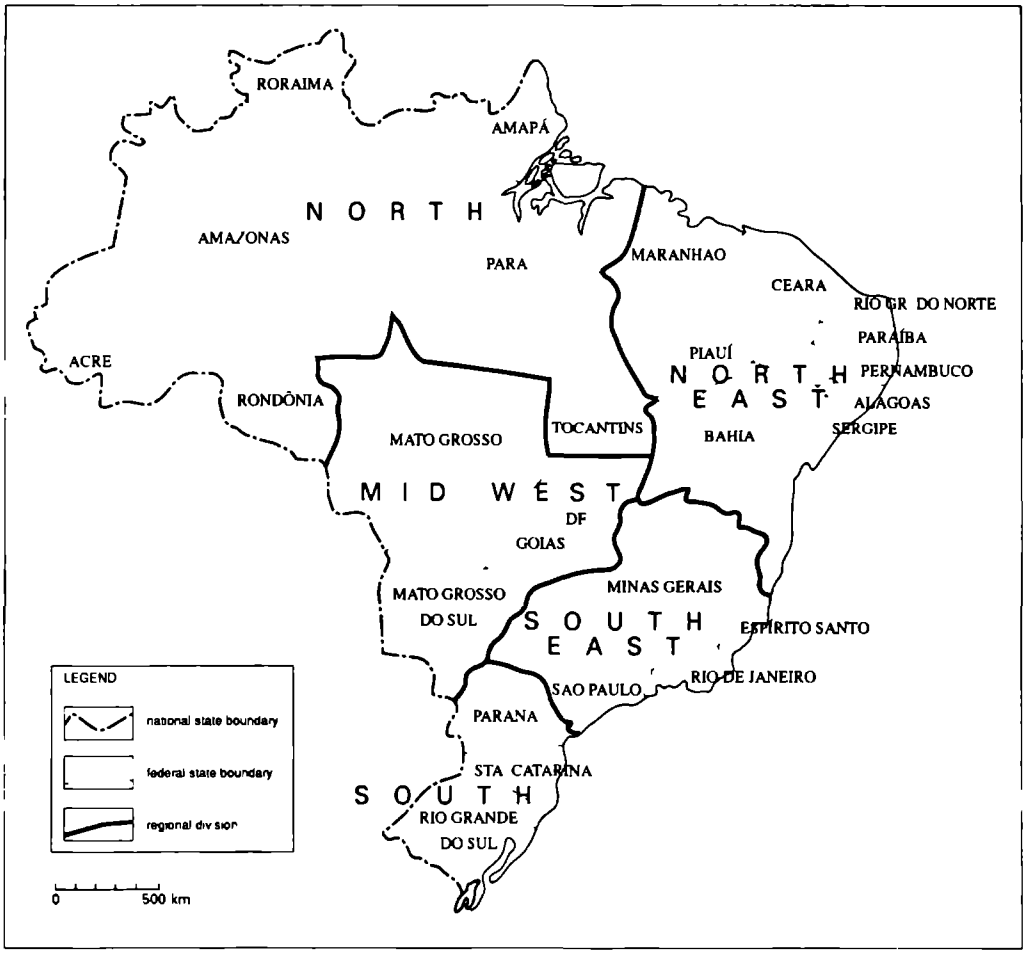

Map 0.1 Regional division of Brazil

TROPICAL HARDWOOD FROM THE BRAZILIAN AMAZON

A STUDY OF THE TIMBER INDUSTRY IN WESTERN PARÁ

Een wetenschappelijke proeve
op het gebied van de Beleidswetenschappen

PROEFSCHRIFT

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aan de Katholieke Universiteit Nijmegen,
volgens besluit van het College van Decanen
in het openbaar te verdedigen
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door

Mirjam Amaranta Fiametta Ros-Tonen

geboren op 26 december 1956
te Utrecht

Promotor: Prof. dr. J.M.G. Kleinpenning

To Wynand and Sanne

Preface

Commercial logging is of topical interest because of world-wide concern about the loss of tropical forests. Relatively little is known, however, about the timber industry and its effects on the deforestation and development of the Brazilian Amazon region. This has stimulated the Department of Human Geography of Developing Areas to work out a proposal for this study. I am indebted to professor Kleinpenning and Ir. B. Lof for their initiating work, which eventually resulted in gaining the financial support of the Netherlands Foundation for the Advancement of Tropical Research (WOTRO).

Numerous people and institutions contributed to the work which has resulted in this dissertation. First of all I would like to thank my supervisor, Prof. dr. Kleinpenning for providing the conditions within which I could work autonomously, whilst being there to give advice if I needed it.

In Brazil, many researchers contributed suggestions for a more detailed elaboration of my research plans. Especially the ideas of José Rent Nascimento (IPEA, Brasília), Chris Uhl (associated researcher at EMBRAPA, Belém), Adalberto Veríssimo (IMAZON, Belém) and Ima Vieira (Museu Goeldi, Belém) have influenced the way in which the fieldwork has been carried out. I would also like to thank Ima for taking me to Paragominas and for her acting as a guide to me during the days I was there.

Without the support of Perminio da Costa Filho (EMBRAPA, Belém) it would have been much more difficult to find my way through the numerous institutions which were relevant for this study. His introducing me to various institutions and individuals in both Belém and Santarém was of incalculable value.

I am also appreciative of the institutional support from the *Núcleo dos Altos Estudos Amazônicos* of the Federal University of Pará in Belém, which gave me the opportunity to have the status of associated researcher.

I would like to thank Mr. G. Bartels and his family for offering me a home abroad when I was in Belém. I will not easily forget his and his wife's help when I needed medical assistance. In addition, Mr. Bartels introduced me to the timber producers of Santarém and took me on an instructive trip visiting sawmills in the colonization areas south of Belém

which allowed me to gain an impression of frontier development and timber exploitation in another part of Pará.

In Santarém I found a home and a friend with Socorro Pena. I was impressed with her commitment to the social and ecological problems of the Amazon region. She contributed in many ways to this study through her interest in the progress of the fieldwork, through discussing my observations and findings, through establishing the contacts with grass-roots organizations and through participating in the interviews with the workers.

The enthusiastic assistance of Mr. Carlos Bordalo in the phase of data collection was indispensable to the success of this study. He carefully interviewed sawmill owners and managers of timber companies and assisted in many other ways in the execution of the fieldwork. In addition, he was good company during trips into the interior.

Rosivete Ferreira worked with great zeal transcribing interviews with lumbermen and representatives of social organizations. Together with other members of the Group for the Defence of the Amazon she also participated in the interviews with workers in the timber industry.

I further wish to thank everyone involved in the last phase of writing this book: Mrs. M. van Dalen-Meijer for her moral support and functioning as an intermediary between my study at home and the University after I found a new job; Mr. Paul Wissink for drawing the maps; Mrs. Angela Needham for correcting my English, Adolfo López Mejía for correcting the Portuguese summary and conclusions and Mrs. Wanda Tammens-de Rooij for her suggestions for improvements in the manuscript. Dr. N.R. de Graaf contributed some helpful comments and suggestions concerning the silvicultural aspects of tropical rain forest logging.

I am indebted to my colleagues of the Tropenbos Foundation, and to Mr. Erik Lammerts van Bueren in particular, who generously enabled me to finish my dissertation after starting my new job.

Two people have prevented life consisting of nothing but work and I would like to thank them for this. The first is my mother, with whom I share a passion for playing Scrabble. Our weekly game has always been a welcome distraction. The second is my daughter Sanne, who was born when writing was about to start. To see her enjoyment of life, watch her laugh and observe how she can be wrapped up in her play has considerably enriched my life.

Finally, and most of all I wish to extend my heartfelt thanks to my husband, Wynand. Words fail to describe the manifold aspects of his support. He stimulated me to undertake this effort, always lent a willing ear when I wanted to discuss the design of the study, the processing of the data or the wording of a text and he created the conditions at home which allowed me to complete my work. I dedicate this book to him and to our daughter.

Contents

List of Tables

List of Maps

1 Introduction

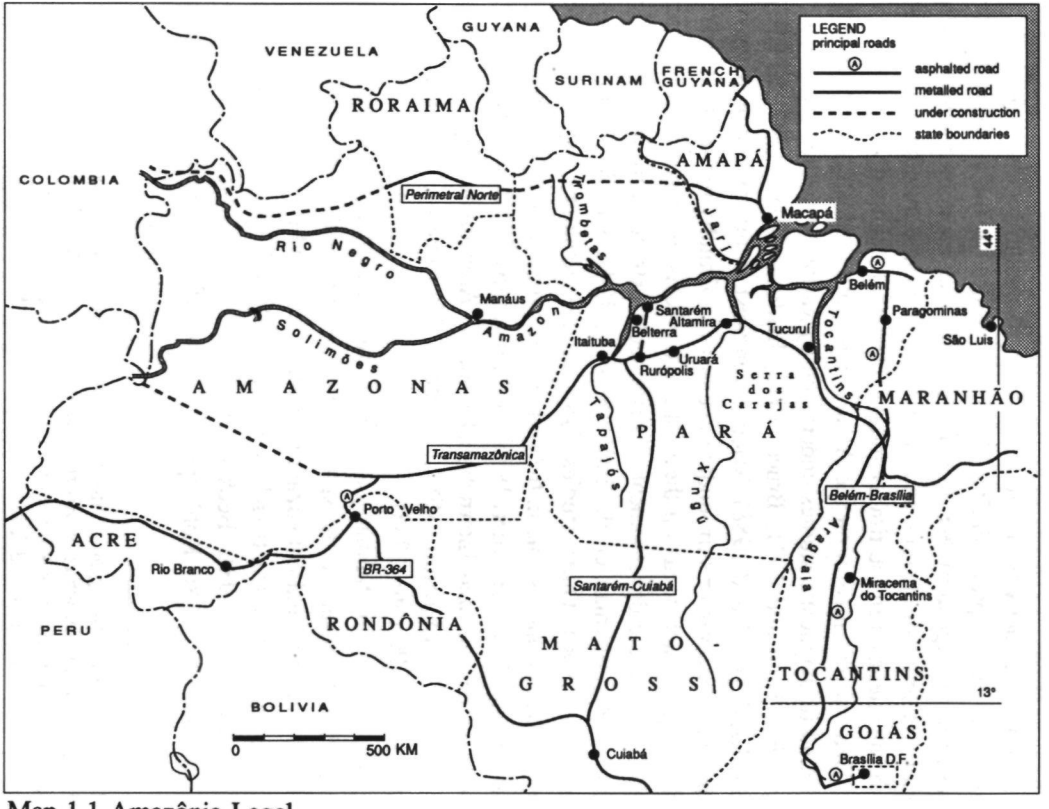
1.1 Purpose of the present study

One economic activity in the Brazilian Amazon region[1] which has developed very rapidly during the last decades is the extraction and processing of tropical timber. In contrast with other economic sectors, such as cattle raising, commercial and subsistence farming or mining, the interest of social scientists in the timber industry has been minimal.

General information on the Amazonian timber industry can primarily be found in diagnostic studies undertaken by various Brazilian institutions (Knowles, 1966 and 1971; Bruce, 1976; Britto & Kishi, 1981; UFRRJ, 1984; IBDF, 1984 and 1988). Scientific interest in the timber industry of Brazilian Amazonia or surrounding countries is virtually limited to forestry and ecology which focus on the ecological effects of commercial logging operations and the development of sustainable extraction methods (e.g. de Graaf, 1982; Boxman et al., 1985; Jonkers, 1987; Uhl & Vieira, 1989; Hendrison, 1990). Other studies focus on the economic aspects of the timber industry and its role in the rural development of the Amazon region (Nascimento, 1985; Browder, 1986). A third group of studies emphasize the commercialization and international trade of Amazonian forest products (Soares, 1971; Mercado, 1980; Nahuz, 1982; Santos & Costa, 1985; Vantomme & Peixoto, 1985).

The interest of human geographers in Amazonian development has mainly been focused on the spatial aspects of regional development, such as the occupation and colonization of the region and the expansion of the 'frontier' or pioneer fronts (Kleinpenning 1975, 1977 and 1978; Katzman, 1977; Foweraker, 1981; Becker, 1982; Volbeda, 1984; Bunker, 1985; Kohlhepp & Coy, 1986; Kohlhepp, 1987; Coy, 1988). From this perspective

1. The terms 'Amazon region', 'Amazonia' and 'the Amazon' are used interchangeably and refer to the region which in Brazil is called 'Amazônia Legal'. It comprises an area of almost 5 million square kilometres and was delimited as such in 1953 for planning purposes. It covers the actual federal states of Amapá, Pará, Maranhão (west of the 44th degree), Tocantins, Mato Grosso, Rondônia, Acre, Amazonas and Roraima in northern Brazil (Map 1.1). The 'North' or 'northern region', covering 3.8 million square kilometres, is an area delimited for statistical purposes by the Brazilian Institute for Geography and Statistics and covers the Legal Amazon without the parts of the states of Maranhão and Mato Grosso (inner side front cover).



Map 1.1 Amazônia Legal.

some sector studies have been undertaken, e.g. on cattle raising by Hecht (1982) and Poelhekke (1984).

There are few studies on the timber industry which integrate the several different lines of approach.[2] The present study is an attempt to fill this gap. Its objective is to analyse the principal features and effects of the timber sector and to evaluate its role in the socio-economic development of the region. The latter cannot be done without considering the question of the ecological effects and the sustainability of timber extraction.

A study such as this is not only of relevance to science. In the past, the Brazilian government has launched several plans to promote the sustainable production of timber in selected areas of the Amazon region. It has been argued that the exploitation of forest products is an economic activity which is perfectly suited to the physical environment of the Amazon region where 30% of the world's tropical forests are located. Advocates of a further expansion of the timber industry point to its contribution to the tax revenues and to foreign currency, the generation of employment and other social and economic benefits. On the other hand, environmentalists and other opponents of special incentives for the timber sector point to the ecological damage of logging, bad labour conditions, low employment figures and conflicts with other land users such as the indians, the inhabitants of traditional river communities (*caboclos*), small farmers and land squatters (*posseiros*). These discussions, too, often take place without sufficient knowledge of the facts about the real situation.

Finally, there is world-wide concern about the increasing loss of tropical forests. In this context, commercial logging and the international timber trade often reach the headlines because of their supposed contribution to deforestation. Opinions differ on this issue, too. Some experts estimate the contribution of commercial timber extraction at 15% of total deforestation (FAO, cited in Jonsson & Lindgren, 1990); others point to the indirect effects of logging operations and conclude that it is the principle catalyst in the destruction of tropical rain forests (Myers, 1984; Nectoux & Dudley, 1987). The latter view results in campaigns to boycott the imports of timber which is not produced on a sustainable basis. As there

2. A few exceptions can be found within Brazil itself, where young researchers have written unpublished Masters theses about the timber industry and its relationship to the development of the Amazon region (Queroz Filho, 1983; Costa Filho, 1983; Almeida, 1985; Santos, 1986; da Silva, 1987; Souza, 1988).

is little information about the context of timber exploitation in the Amazon region, it is not known what trade restrictions will be able to achieve as far as the Amazon is concerned.

There are therefore several reasons for undertaking an integrated study on the timber sector in Amazonia. The more so, as 'sustainable development' in its broadest sense is currently a hotly debated topic in environment and development thinking.

In the light of this, the principal research question can be formulated as follows:

> What spatial and socio-economic features characterize the Amazonian timber industry, what is its role in the regional development process and in the incorporation of the Amazon into the national and international economy and what are the socio-economic and ecological consequences of timber exploitation?

This general question can be split into four sub-questions:

1. What are the spatial and socio-economic features of the Amazonian timber industry and how has it been influenced by planned and spontaneous developments?
2. What forms of roundwood supplies exist in the Brazilian Amazon, what are the ecological effects of logging operations and what are the prospects for the sustainable production of timber?
3. In what way does the timber sector contribute to the socio-economic development of the Amazon Region and to its incorporation into the national and international economy?
4. How is the development of the Amazonian timber sector related to the national and international market for tropical hardwood and what is the possible effect of trade restrictions concerning timber from unsustainably managed forests?

A further elaboration of the question on the role of the timber industry in the development process will be provided in the next section.

1.2 Timber production for development: a review of the debate

The notion that the exploitation of forest resources and the industrial processing of forest products could be instrumental in promoting development originated thirty years ago when Westoby (1962) published an article on this subject. His arguments for encouraging investments in forest industries in order to attack economic underdevelopment exerted considerable influence on forestry policies during the 1960s and 1970s. The impact of his reasoning on the sector's development was such, that some authors refer to it as 'the original Westoby view' (Douglas, 1983) and 'the Westoby Mk. I model' (Leslie, 1985).

In his publication of 1962, Westoby argued that forest industries could play a significant role in the economic development of low income countries because of their propulsive character and other specific features. Raw material for the timber industry is locally available on a renewable basis in virtually all developing countries, as they all possess forests or could create them by establishing plantations. The products - a wide range of intermediate and consumer goods - flow into many sectors of the economy such as mining, construction, transport, shipbuilding, furniture manufacturing and packing. Because of these backward and particularly strong forward linkages, forest-based industries could induce spontaneous investments in other branches of production. But the sector also tends to be self-propelling: installing some forest industries often provokes complementary production in the same area, based on the utilization of residues. Due to these intra and inter-sectoral links, investments in forest industries were expected to exercise a strong multiplier effect on the whole economy.

Another advantage of the forest industry, according to Westoby, is its flexibility with regard to scale of operation and technology. This is particularly important in developing countries where capital tends to be scarce and labour abundant. Expensive mechanization - both in extraction and processing - can be postponed and unskilled labour can be used instead. Since work in forestry, such as silvicultural treatments and the harvesting of wood, is not bound to such a strict time schedule as is agricultural work, the forestry sector was supposed to be capable of absorbing temporarily idle labour.

Other arguments refer to the local needs for wood products, the income elasticity of demand and the positive effect of local wood processing on the

balance of payments. Forest industries provide goods essential to material well-being and human dignity such as suitable housing and furniture. Moreover, income elasticity is high: demand tends to rise sharply with economic growth. This means that the domestic market for wood products was expected to expand rapidly in most developing countries. Without a corresponding expansion of the production capacity this would imply an additional burden on the balance of payments. Hence, the expansion of forest industries would affect the balance of payments positively through its import-saving effect. Moreover, it could be a source of foreign currency through the exports of manufactured products.

A final aspect relevant to the development of the most peripheral regions in particular, was seen in the locational aspects of forest industries. Due to the difficulty and the high costs of transporting bulky loads of unprocessed wood and the weight-losing character of forestry industries, the most attractive location for forest industries is as close to the source of raw material as possible. This aspect, so it was expected, would offer good prospects for the creation of new poles of development in the periphery. New roads would open up previously closed forest areas and contribute to the extension of the regional road system, whereas the infrastructure for the forestry sector could also serve other industries.

The arguments as put forward by Westoby strongly reflected the current thinking about economic development at the time.[3] It is remarkable that even after these theories had been superseded, Westoby's arguments continued to be repeated by many authors, such as Gregory (1965), Sartorius & Henle (1968), MacGregor (1976) and King (1980). Some of them also complemented Westoby's view on the role of forestry and forest industries in development.

Gregory (1965), adopting Westoby's arguments for Latin America, added to them the crucial role of forests in what he called 'land reform' programmes. Opening forested areas to colonization, he argued, could substantially relieve the pressure for change in unequal land-holding patterns. As we will see in Chapter 2, this argument had been used in the

3. Theories on economic development prevailing in the early 1960s and which were reflected in Westoby's reasoning were Myrdal's principle of circular and cumulative causation (1957), Hirschman's trickle-down approach through backward and forward linkage effects (1958), and the stages of growth theory by Rostow (1962). A summarized review of these theories can be found in Van Naerssen (1979).

1970s by the Brazilian military government to promote the opening up and colonization of the Amazon region under the motto: 'to bring people without land to land without people'. Today's reality shows that the concentration of landownership is stronger and that conflicts over land are more violent in the Amazon, than in other regions of Brazil.

Analogous to Westoby's assumption that forest industries could create new development poles in peripheral regions, Gregory stated that the establishment of these industries could initiate new settlements. In the initial phase of settlement, forest industries are established to utilize the timber to be removed for clearings and to furnish materials for construction. Gregory predicted that many of these industries would remain after this initial phase being provided with raw material from woodlots maintained by settlers and drawing on farms for temporarily idle labour. In Chapters 4 and 6 the relationship between the timber industry and frontier settlement will be dealt with in more detail.

Gregory also emphasized that, in addition to wood products, forests - either natural or man-made - also provide what he called 'social services'. In this context he referred to what others would prefer to call the forest's ecological functions, such as shelterbelts for wind protection, prevention of soil erosion by wind and water, protection against the silting up of reservoirs and the protection of wildlife. He also added to this the forest's recreational facilities. These functions, too, play their role in the development process.

In addition to a further elaboration of the aforementioned arguments, Sartorius & Henle (1968) paid special attention to forestry as a source of employment and to its role in fixing the population in rural areas. They stressed that forestry, in addition to its direct labour needs in extraction, road construction and management, has a strong multiplicative effect on primary and secondary industries, world-wide.

Of particular interest is their consideration of the social aspects of forestry employment. They paid attention to the low wages relative to other sectors in the economy. With respect to safety and health, they pointed to the fact that the noises and/or vibrations produced by many forestry machines, may have an adverse effect on the health of those who work for long periods with such machines. They also highlighted the fact that traditional forest work is one of the most strenuous and energy-consuming of all occupations, requiring 5,000 to 6,000 calories per day. According to Sartorius & Henle, work in forestry is also one of the most accident-

producing occupations. These accidents are often attributed to the lack of proper training, inadequate tools, inappropriate working methods and insufficient safety and accident prevention measures. To these causes Sartorius & Henle added the insights provided by research on the limits of physical stress and rhythms of work in the tropics. Instead of 'general laziness' or 'inborn aversion to systematic work' they ascribed absenteeism among the labour force to inadequate nourishment in relation to the heavy demands made on their physical resources, to ill-adapted work schedules and to the accumulation of fatigue during unbroken working days.

> 'After a prolonged period of tiredness, labourers seem to be limited to the choice of succumbing either to accidents, to illness, or to forced interruption of their work. They more or less instinctively choose the last one in order to avoid either of the other two' (Sartorius & Henle, 1968:187).

One of the last adherents of Westoby's arguments for promoting forestry and forest-based industries in underdeveloped economies was King (1980). His conviction that forestry and forest industries could contribute to economic development seems slightly strange in the light of his conclusions that the sector had so far failed to reduce chronic deficits on the balance of payments or the level of unemployment. He argued that developing countries did not benefit from the value added through the processing of the wood, nor from the forward linkage effects of the forest industries as most of the wood had been exported as raw material. Neither had the exploitation of forests benefited the rural poor as the resource was either underutilized or mismanaged and over-exploited. Despite these conclusions, King believed in the validity of Westoby's arguments, provided that (1) the forests were properly managed, (2) conversion and processing were undertaken in the exporting countries, (3) forest industries were established judiciously, and (4) advances in modern technology were fully exploited.

This optimistic view of industrialized forestry development, however, was no longer shared by its original advocate. In his address to the Eighth World Forestry Congress in Jakarta (1978), more than fifteen years after the publication of his article in Unasylva, Westoby concluded that:

- forestry projects had been subordinate to the needs of rich countries for wood material and the opportunities for profit of their forest industries;

- most tropical hardwood was exported as unprocessed roundwood, thus limiting the potential positive effect on employment, incomes and foreign exchange;
- forest services had been established in virtually all developing countries but all of them were weak as the result of understaffing, underpayment and inadequate equipment. Due to their weakness, control had been ineffective and forest management continued to be non-existent. This also resulted in an influx of marginal farmers in the wake of loggers, who completed forest destruction.

The following quotation reflects how Westoby looked back upon the forestry projects which were implemented during the 1960s and 1970s:

> 'Because nearly all the forest and forestry industry development which has taken place in the underdeveloped world over the last decades has been externally oriented, aimed at satisfying the rocketing demands of the rich, industrialised nations, the basic forest products needs of the peoples of the underdeveloped world are further from being satisfied than ever: their need for fuel, building materials, low-cost housing, cheap furniture, industrial and cultural papers. The famous multiplier effects are missing. Few new poles of development have been created. The weak forest services in the underdeveloped world are largely concerned with assuring and facilitating a steady outflow of wood raw material to the rich countries. Of the new revenues generated, woefully little has been ploughed back into forestry, either into management, into regeneration or new planting, or into research. (...) In precious few countries have the energies of foresters been bent upon helping the peasant to develop the kind of forestry that would serve his material welfare' (Westoby, 1978:23).

As can be gathered from this quotation, a shift had taken place in the thinking about forestry as a source of industrial roundwood towards the idea that forestry has a role to play on behalf of the small farmer and landless poor. This shift in focus is also reflected in the FAO Forestry Paper on Forestry and Rural Development (1981) in which similar arguments have been used to illustrate that the rural poor had gained little by the increasing demand for industrial roundwood.

'Not being the titular owners of commercial forests (...) their only benefit from sales has been the opportunity for some employment. Being unable to compete with the prices paid by industrial buyers, they have lost the freedom to use the wood for their own needs. (...) Villagers now have to make do with inferior woods' (FAO, 1981:9).

A new starting point for FAO forestry policy at the beginning of the 1980s was that the economic and social development of the rural poor would relieve some of the pressure on forests. This socio-economic development was to be achieved through the effective integration of tree-growing, arable farming and animal husbandry. The supportive role of forestry in rural development was now seen in its ecological functions (catchment protection, wild life conservation and soil erosion control) and the supply of forest products both for local consumption (including fuelwood and non-wood products) and for industrial uses. Particular attention was to be given to the supply of fuelwood and to the involvement and participation of poor men and women in tree planting and forest management. The role of wood-processing industries is seen in the production of goods to satisfy the local needs for timber for housing, furniture and agricultural tools. This new approach of forestry became known as social or community forestry.[4]

The most recent discussions with regard to the role of forestry are related to the concept of sustainable development. The latest shift in focus should be seen against the background of increasing rates of deforestation and degradation of tropical forests. With regard to timber exploitation official and public concern is directed towards forest conservation and the sustainable management of tropical forest resources. With respect to the socio-economic aspects of forestry, current topical issues are land tenure, the exploitation of non-wood forest products and their role in the survival strategies of local people, the position of the indigenous population and the formulation of national plans for the conservation and wise utilization of tropical forests (de Groot et al., 1991).

4. For a more detailed review of people-centred approaches in forestry see Westoby, 1989.

Various authors have pointed to the fact that the changing views on the role of forestry in the development process proceed from the changes in the concept of development and the underlying development theories (Douglas, 1983; Dargavel et al., 1985, Hobley & Kengen, 1985; Wiersum, 1988/ 1989). Theories on underdevelopment have been successively dominated by modernization thinking, dependency views, the redistribution and basic needs approach and post-marxist and post-modern views. In the latter, gender relations, social movements and sustainable development have become the central themes.[5] Ideas on how to cure underdeveloped economies and the role that forestry and forest-related industries could play in that process have changed in accordance with these views.

At this point it seems useful to clarify what we understand by development and how this view guides our evaluation of the role of the Amazonian timber industry in the region's social and economic development. In our view, development is a process which implies:

- the increasing availability of goods and services to satisfy the basic needs of an increasing number of people, such as food, shelter, elementary health and education;
- the reduction of severe disparities in the distribution of income and/or access to land and other resources among people of different class, race and gender;
- the increasing capacity of the poor to control and act upon the development process of which they form part;
- the maintenance of the earth's capacity to meet basic needs in the future.

From this definition emanate the following questions, which are used to evaluate the contribution of the timber industry to the development of the Amazon region:

1. Does the timber industry further or hinder the satisfaction of local needs?
2. Does the timber industry improve the incomes of the poor through the creation of employment? Does it create alternative sources of income for farmers? Do profits benefit the region? Does timber exploitation affect access to land and forest resources for other land-users?

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5. For an overview of recent debates in development thinking see Ros-Tonen & Custers, 1992.

3. Are local people - through their social organizations - involved in the development of the timber industry?
4. Does the timber industry contribute to the sustainable development of the Amazon region?

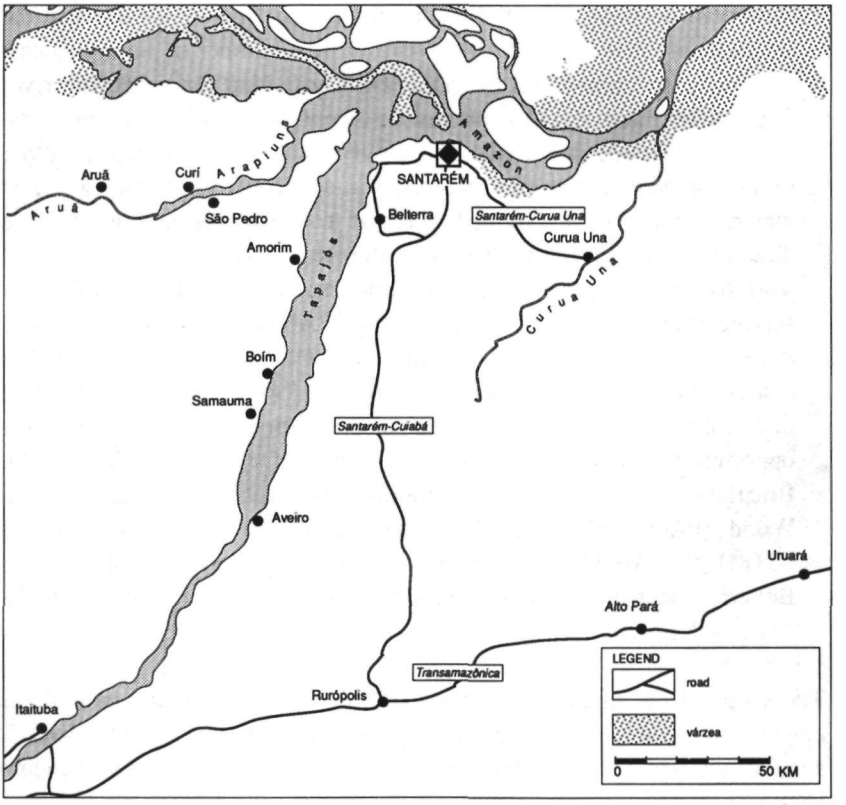
Most of these questions will be dealt with in Chapter 6 when we discuss the socio-economic dimensions of the timber industry. More detailed information about the market orientation of wood-processing industries can be found in Chapter 7. The question about the timber sector's contribution to the sustainable development of the Amazon region will be discussed in Chapter 5.

1.3 Research area

We undertook fieldwork from May to November 1989 in the western part of the state of Pará in the municipalities of Santarém, Rurópolis and Uruará, in the environs of the city of Santarém (Map 1.2). This area, approximately 30,000 km^2 in extent, is intersected by three roads, along which the region's sawmills are located: the Santarém-Cuiabá road as far as the Transamazônica (217 km.), the Transamazônica between the western border of the municipality of Rurópolis and the eastern border of the municipality of Uruará (240 km.) and the Santarém-Curua Una road (60 km.).

The land along the roads was colonized during the 1970s, being divided into family holdings of 100 ha. each. On these holdings peasants grow subsistence crops, such as manioc, rice and beans. They sell their surplus and some fruits like bananas, lemons, oranges, papayas, watermelons and Brazil nuts. The region's principal cash crops are black pepper, cocoa and jute. Some landholders own properties larger than 10,000 ha. In general, cattle ranching is practised on these large holdings. In addition to agriculture, gold mining and the timber industry form the cornerstones of the regional economy.

Commercial logging is an old practice in the region, and was used principally to satisfy local demand. But Santarém, located at the confluence of the Tapajós and the Amazon rivers and provided with good port facilities, is also one of the older Amazonian centres for timber exports. The number of sawmills in the city has been fairly stable for the last fifteen years (about thirty). In the interior, however, many new sawmills came into existence, most of them established no longer than five years ago. They are all situated along the roads in the colonization areas.



Map 1.2 The study area.

Several reasons have influenced the selection of the region of Santarém:

- The region offered the opportunity to study both traditional and modern forms of timber extraction, whether related to the clearings in recently occupied areas or not. It is a region where timber exploitation has a longer history than in areas where this activity has developed as a result of the recent opening-up of new areas.
- In the region both river-based and road-based forest exploitation can be found. In the first instance exploitation takes place in forests which are only accessible by river. In the latter instance timber is extracted from forests opened up by new roads.
- In comparison with other logging areas in the Amazon, conditions for surveying the activities of the timber industry are more favourable.

Timber processing is mainly concentrated in Santarém city and the sawmills are provided with logs via a limited number of supply routes: the Santarém-Cuiabá and the Santarém-Curua Una roads and the river Tapajós. Furthermore, there are sawmills (predominantly small) along the two supply roads mentioned and along the Transamazônica. In other important wood-processing centres, such as Belém and Manáus, raw material is not only supplied over greater distances and from more directions, but the source of logs is often unknown.

- Various relevant government institutions, such as the Brazilian forestry service (the former IBDF and present IBAMA), the federal regional development agency for the Amazon (SUDAM) and the Brazilian institute for agricultural research (EMBRAPA) - which is also engaged in forestry - are present in this region. In addition, Santarém offered the opportunity to analyse the effects of various forestry initiatives of the Brazilian government, like the Programme of Entrepôts for Exportation Wood (PROMAEX), the Technological Wood Centre in Santarém (CTM), the experimental stations for forestry research Curua-Una and Belterra and the programme for sustainable forest management in the Tapajós National Forest.

The scope of the survey has been restricted to enterprises and individuals engaged in logging, primary processing and/or trading of tropical hardwood, such as autonomous lumbermen, sawmills and veneer and plywood industries.

We excluded timber extraction for use as fuelwood or raw material for paper or charcoal production. The production of fuelwood was not included because it is virtually insignificant in the sparsely populated Amazon.[6] Moreover, our interest concerned timber exploitation as an economic activity. Unlike the exploitation of tropical hardwood, the gathering of fuelwood is generally not a commercial activity.

Another activity which played a marginal role in the Amazonian economy until recently is the production of charcoal. It has virtually no links with the exploitation of tropical hardwood except for a few cases in

6. The northern region produced 11%, 2.3% and 72.1%, respectively, of the total Brazilian production of fuelwood, charcoal and roundwood in 1989. The total value of the production amounted to Cr$ 10.7 billion in 1989, of which fuelwood contributed 2.9%, charcoal 1.0% and roundwood 96.1% (IBGE, 1991).

which it is produced from the residuals of timber processing. Labour and production conditions are so different that they must be regarded as two separate sectors. Charcoal production is also a relatively new phenomenon in the Amazon and is primarily related to the Grande Carajás programme for exploiting the world's largest deposit of iron ore in the central part of the state Pará. The programme offers incentives to charcoal production for use in pig iron mills (Fearnside, 1988). Although this issue deserves special attention because of the allied ecological threat and social problems, it nevertheless remains beyond the scope of this study.

No tropical hardwood is used in paper production. For that reason the Brazilian paper and pulp industry is concentrated in the more temperate zones of southeastern and southern Brazil, where cheaper wood grows in plantations of *Pinus* and *Eucalyptus* (Vantomme & Peixoto, 1985). An exceptional case in the Amazon is the ambitious Jarí project in the border area of the states of Pará and Amapá, initiated by the American D.K. Ludwig in 1967 and now in Brazilian hands. Until 1985, an area of 98,000 ha of tropical rain forest had been converted into silvicultural plantations of *Gmelina*, *Eucalyptus* and *Pinus* for use in the project's pulp mill (Fearnside & Rankin, 1982 and 1988; Jarí, 1985). This project is quite exceptional in the Amazon and has practically no relation with the region's timber industry, which is the subject of our study.

1.4 Methodology

We used various methods and approached different research units to find an answer to the research questions mentioned in section 1.1. Information on the following themes was principally based on bibliographical research:

- the Brazilian government policy with respect to the development of the Amazon region and the timber industry;
- features of the national forestry sector and the timber industry in other regions within the Amazon;
- the international dimensions of Amazonian timber production; and
- the ecological effects of logging operations.

To this end we undertook a fact-finding tour through Brazil from May to October 1988, visiting universities, research institutes, national, regional and local government departments, non-governmental organizations and industrial associations in Rio de Janeiro, São Paulo, Belo Horizonte, Brasília and the major Amazonian cities of Belém, Santarém, Manáus, Porto

Velho and Rio Branco. A list of these institutions is included in Appendix 1. They provided different kinds of supportive material, such as statistics, documentation, official reports and unpublished manuscripts. The material and information gathered during this tour also helped in the definitive selection of our study area and in supplementing and comparing the results of our field work with those of other studies.

An additional source of bibliographic material has been the Latin American Library of the University of Florida in Gainesville, USA, visited in 1991.

To collect data about the features of the timber industry in our study area we interviewed owners and/or managers of timber companies and sawmills, using a semi-structured questionnaire. This questionnaire was tested in 10 companies which we had visited in Paragominas and Santarém during our stay in 1988. The topics discussed during these interviews included:

- the location of the sawmill or timber company and the factors that influenced the decision to establish on that specific site;
- the age and origin of the firm;
- the labour input and the way the workers were recruited;
- the input, source and supply channels of raw materials;
- the type and volume of the production;
- the origin of the machines and their spare parts;
- the destination of the production;
- the relations with government institutions;
- the economic aspects of wood-processing activities.

In our study area we initially intended to visit only the firms in the city of Santarém and those along the exit-roads to Cuiabá (up to the Transamazônica) and Curua-Una. During the field-work, however, we decided to include the sawmills along the Transamazônica between Rurópolis and Uruará as some had interviews indicated that the production of these sawmills was highly determined by one or two timber companies located in Santarém city. We also visited a community along the Tapajós river where a timber company from Belém obtained its raw material.

We also included some timber companies in our survey located in Belém. We did so to compensate for the absence of very large companies in the Santarém region itself and to be able to compare their impact with smaller enterprises. Some of these enterprises were selected on the basis of their relation with our study area.

No sample was taken in the study area itself, as the number of enterprises was small enough to visit them all. According to registration records of the Brazilian forestry service and the taxation office the number of sawmills in the Santarém region amounted to 29 in January 1988. Twenty of them were located in the city and nine were to be found along the major roads. The reality proved very different. Official records are incomplete because many sawmills operate without proper registration. In the interior many sawmills are so small, that, even if their owners would be willing to be formally registered, their request is not taken seriously by the functionaries of these institutions. We identified the unregistered sawmills by asking at the end of each interview, where we could find the next sawmill and by repeatedly inquiring about whether our list of sawmills was complete. In this way, we tracked down 64 enterprises in the Santarém Region and we must assume that we have found them all.

Non-response was low (4.9%). Only one interview was refused. A second sawmill, located along the Transamazônica, was finally excluded because its owner was repeatedly absent and no one else wanted to answer in his place. A third sawmill in the interior was not visited because we discovered its existence too late. In total, we had collected data about 71 enterprises engaged in timber processing; 61 in the study area and 10 in Belém. In 47 cases (66.2%) we talked to the owner, in 12 larger companies we interviewed the manager (16.9%) and another 12 respondents (16.9%) were employed in the firm as personnel managers, head of accounts departments, buyers of logs or otherwise.

With respect to these interviews two methodological observations must be added. Firstly, one must bear in mind that the composition of the timber sector is subject to rapid change. It is easy for new firms to enter into sawmilling as the initial investment, product differentiation, the availability of raw material and the level of technology cannot be regarded as serious barriers (Mercado, 1980). Small sawmills are easily established but often also rapidly fail or change owners. Large companies are more stable, but even within this group take-overs, fusions and divisions are manifold. The number of sawmills in Santarém has been fairly stable for the last twenty years, whereas their names and that of their owners have frequently changed.

The second observation refers to the reliability of the quantitative data. During the first interviews in particular it was difficult to get information

about the volume of utilized roundwood, production, sales and profits. Most owners of small firms do no bookkeeping and this results in inaccurate insights into the quantitative aspects of their business. Seasonal fluctuations in the supply of raw materials contribute to strong variations in production and sales for sawmills with inadequate financial means to keep a supply of logs.

Companies with headquarters elsewhere in Brazil do not have these data at their disposal, because these are directly passed on to the parent company.

In some instances, a second visit during which questions on these quantitative data were put once again, was able to clarify most of the uncertainties. In other instances, we had to deduce this information from other data.[7] In later interviews we had gained enough experience in obtaining these quantitative data via indirect questions if this proved to be necessary. Altogether, it is good to bear in mind that these data must be regarded as indications rather than exact figures.

To gain more insight into the supply forms of raw material and the relationship between lumbermen and sawmills, we conducted nine open interviews with autonomous lumbermen (in Portuguese referred to as *madeireiros* or *toreiros*). They are owners of special trucks to transport the logs which they cut on their own land or that of others who sell the trees to them. After felling the trees, they transport the logs to the city and sell them to the sawmills. These people were found having been mentioned by owners and labourers of the wood-processing industries and by their references to each other.

We considered the number of respondents to be sufficient because no new information was added in the last interviews. The interviews resulted in practically identical accounts of their way of working, access to trees and/or land, their relationship with the sawmills, etc.

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7. An example is the volume of sawnwood produced, which can be derived from the volume of roundwood inputs on the basis of a mean conversion rate of 1:2. In cases where the first and second interview yielded strongly divergent data, we opted to use the answer which appeared most reliable in the light of the number of employees and size of the firm.

We also observed logging operations on distinct scales and technological levels. We accompanied a team of loggers from the community of Aruã, located along the Arapiuns river, an affluent of the Tapajós. They removed logs for the local demand of the community, using only a chain saw. To observe wood extraction on a slightly higher technological level, and hence on a larger scale, we accompanied two *madeireiros*. Finally, we observed the logging operations both by a medium-sized sawmill and a large company, who were working on a semi-mechanized and an industrialized level, respectively.

Observation focused on the number of workers, the organization and division of the work, the productivity, damage to the vegetation, provisions concerning food and shelter for the lumbermen or labourers and the risks of labour accidents.

Information about possible conflicts between the actors engaged in timber exploitation and other land users in the region was gathered through:

- documents by grass-roots organizations like the Pastoral Land Committee (CPT), labour unions, the Missionary Council for Indigenous People (CIMI) and the Commission for Human Rights;
- newspaper articles which appeared during the period of the field-work;
- interviews with representatives of the above-mentioned and other grass-roots organizations, such as the Group for the Defence of Amazonia (GDA) and basic communities in villages which were involved in conflicts with timber companies.

Finally we used a short questionnaire with workers in the timber industry in order to get supplementary information about the kind of work, the labour conditions, the way they were recruited and the influence of the timber sector on migration patterns. In total 60 workers were interviewed. For the first respondents we turned to the trade union for workers in the timber industry. Then we continued by asking at the end of each interview whether the respondent could give us three names and addresses of other people working in the timber industry. In this way, we obtained a satisfactory sample of workers from various enterprises and in different functions.

1.5 Outline of the book

The question of how the growth of the Amazonian timber industry has been influenced by planned and spontaneous developments is dealt with in Chapter 2. There we present a brief description of the national forestry sector, focusing on those aspects that help to explain why many timber companies migrated from southern Brazil to the Amazon region. We also look at the impact on the Amazonian timber industry of the Brazilian government's policy to develop the Amazon, to encourage timber production and to conserve the rain forest for future exploitation.

Chapter 3 offers a description of the spatial and general features of the principal production areas and a general characterization of the timber industry in the Santarém region. Chapter 4 deals with the different logging practices and supply forms of roundwood. We distinguish the exploitation of the *terra firme* (non-flooded upland forests) and the *várzea* (seasonally inundated forests along watercourses). We also consider different actors and technological levels and different forms of access to trees or forest land. We pay special attention to the lumbermen who play a central role in the provision of logs to the sawmills.

The ecological aspects of timber extraction are the subject of Chapter 5. We review the ecological effects of logging operations and consider the prospects for sustainable forest management. We also consider local experiments in forest management for the sustainable production of timber, as well as the institutional framework and other conditions considered essential for the achievement of sustainable forest management.

The socio-economic dimensions of timber exploitation are the subject of Chapter 6. We look at the role of the timber industry in the satisfaction of local needs, its significance as a source of employment and income and its place in the colonization process. Social aspects to be considered are labour conditions, conflicts over land and forest resources and the involvement of local people in forestry development.

In Chapter 7 the market for Amazonian timber will be analysed and the impact of trade measures with respect to hardwood from forests which are not managed on a sustainable basis will be assessed.

The last chapter provides a summary of our findings and some concluding remarks.

2 The Amazonian timber industry in a national perspective

For a long time, there was hardly any role for the Amazon to play in the Brazilian timber industry. In 1959 the volume of extracted hardwood logs in the Amazon amounted to 195,000 m^3; less than 3% of the national roundwood production (Knowles, 1971 citing IBGE). By 1989 this volume had been increased to 50,145,998 m^3 and 76.2% of the national roundwood production (IBGE, 1991).[1] In this chapter we look at some factors at national level that help us to explain why the Amazonian timber industry has expanded so rapidly during the past few decades. Firstly, we consider some of the changes in the national forestry sector that had occurred independently of developments in the Amazon region. Then, we turn to the influence of policy measures to encourage forest exploitation in Amazonia. In the last section of this chapter we review some aspects of the Brazilian government policy to open up and to develop the Amazon, which decisively influenced the expansion of the region's timber industry.

2.1 The national forestry sector: some changes

Shortly after World War Two, Brazil could be divided into five forest regions: the Brazilian highlands, the Atlantic coast forest, the Guyana highlands, the Parana pine region and the Amazon basin (FAO, 1946).

The Brazilian highland forests, once located in northeastern Brazil and in the state of Espírito Santo, were dense forests of hardwood in which highly valuable species like peroba, brazilwood and rosewood could be found. Extraction of these precious woods had already started in colonial times. Due to 400 years of excessive exploitation and the extensive clearing for agriculture, there is now nothing left of this forest but two reserves with a total area of 132,062 ha in the Linhares region in the state of Espírito Santo (Morães, Oliveira & Lago, 1988). The remaining areas, which are protected by law, are now unsuitable for timber exploitation. In recent publications that review the Brazilian native forests (e.g. Nahuz, 1988), the highland forests are no longer mentioned.

1. Northern region plus Mato Grosso and Maranhão.

The Atlantic forest originally covered a wide strip along the eastern coast from 6°S in the northern state of Rio Grande do Norte to 30°S in the most southern state of Rio Grande do Sul. It used to be a forest even richer in species than the Amazon. Its current area is 3 million ha, at the most (Nahuz, 1988). Large quantities of wood have been removed for fuel, charcoal, sleepers and sawnwood (FAO, 1946; Nahuz, 1985). As with the former highland forests, most parts of the remaining forest are now under protection.

The Guyana highland forests - known in Brazil as the forests of the *Planalto do Amazonas-Orenoco* - are located on the southern slopes of the mountain range between the Amazon and Orinoco basins. They have never been of any significance to the timber industry as they are barely accessible, contain few commercial tree species and are characterized by trees with a relatively small diameter (Bohrer & Gonçalves, 1991).

A fourth forest area is the Parana pine region in the southern states of Paraná, Santa Catarina and Rio Grande do Sul. From the beginning of this century industrial timber processing has been concentrated close to these dense and fairly homogeneous forests. On each hectare 270 m^3 of prime Parana pine (*Araucaria angustifolia*) could be found among other commercial species (Nahuz, 1988). For a long time, this high quality softwood species, which has a very broad range of uses, has been the major export product of the Brazilian timber industry.[2]

In addition to its rich forest resources, the southern region also belongs to the most developed part of Brazil, having favourable conditions for industrial development. As late as in 1983, 40% of the national mechanical timber processing industries and 55.5% of the production capacity installed was still to be found in the South (Morães et al., 1988 citing UFRRJ, 1984).[3]

In spite of the enormous forest resources of the Amazon, the national timber industry has long been reluctant to exploit them. The Amazon region was regarded as the remote, inaccessible and hostile 'green hell'.

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2. In 1971 Parana pine constituted 65% of the Brazilian timber exports. Five years later this had already dropped to 37% (CACEX, 1978). Its significance in the past is well illustrated by the following quotation: 'Parana pine, although occupying a relatively small portion of Brazil is of greater economic importance than the thousands of square miles of hardwood forests in the entire Amazon' (FAO, 1946:30).

3. This percentage does not include papermills or charcoal ovens.

Map 2.1 Forest areas in Brazil (based on Vantomme & Peixoto, 1985).

Transportation costs were high, due to the lack of infrastructure and the inability of many Amazonian woods to float. The heterogeneity of the forest made exploitation expensive; more than hundred different species per hectare is not unusual (Freitas, 1985 citing RADAMBRASIL). Most of them are still unknown botanically or have no commercial value. The maximum number of trees of the same species per hectare is generally less than ten (Dourojeanni, 1981).

Many other factors have contributed to the long-standing fact that the Amazonian forests have been unattractive propositions for timber exploitation. The Brazilian Association of Timber Producers (ABPM, 1979)

mentions the lack of skilled labour, the heavy rainfall, the fact that timber can only be extracted in the dry season, difficulties in using the forestry equipment to which they were accustomed, the lack of governmental support for the timber industry and the lack of supervision of the indiscriminate logging practices of land-grabbers, traditional lumbermen and adventurers. To these factors Dourojeanni (1981) adds the density and slow growth rates of Amazonian hardwood, the lack of knowledge of the physical mechanical and chemical characteristics of most species and the resistance of the markets to the introduction of new species. Fearnside (1988) points to the fact that Amazonian timbers are difficult to saw and that most of them are dark coloured. That makes it hard to introduce them into the European and North American markets where consumers are accustomed to light timber species such as oak and maple.

One of the reasons for overcoming the reluctance of utilizing the resource of Amazonian timber seems obvious: due to heavy over-exploitation and the expansion of agricultural land, the *Araucaria* forests have virtually disappeared. Having originally covered some 8 million ha, their total extent had been reduced to 2.5 million ha by 1950 (Nahuz, 1988). According to the IBDF (1983), the current area of *Araucaria* forests is less than 270,000 ha. The southern states, which at the beginning of the century had 40% (Rio Grande do Sul) to 85% (Paraná) of their area covered with forests, now have barely enough forest area to guarantee the protection of soils, hydrological regimes, flora and fauna (Morães et al., 1988). The region's timber industry had of necessity to turn to other forest resources, either by substituting their raw materials or by displacing the sawmills. The forests of the Guyana highlands were not of interest because of their isolated location and their commercially poor composition. The Atlantic and highlands forests had already been depleted. The Amazon forest was therefore practically the only alternative left. As the latest complete forest inventory showed, 82.4% of the natural forests were located in the North in 1978 (Table 2.1; Map 2.1).[4]

4. This figure is based on the forest inventory made by the RADAMBRASIL project of 1978. More recent data are not available for the country as a whole. The IBDF started another inventory by the end of the 1970s. The results of this inventory in the southern, southeastern and midwest regions were published in 1983 (IBDF, 1983). To complete these figures for the country as a whole too many sources are needed to be able to produce a reliable result. The sources available cannot be compared with respect to their definition of 'natural forest' and their year of reference.

Table 2.1 Forest areas in Brazil (x 1,000 ha)

Region	Natural forests[1]		Man-made forests	
	Area (1,000 ha)	% of total area	Area (1,000 ha)	% of total area
South	5,450	9.7	694.9[2]	1.2
Southeast	7,581	8.3	1,764.8[2]	1.9
Mid-West	30,899[3]	16.4	610.1[4]	0.3
Northeast	12,172	7.9	924.3[5]	0.6
North	263,325	74.1	160.0[6]	0.0
Total	319,427	37.8	4,154.1	0.5

1. Nahuz, 1985 based on RADAMBRASIL, 1978; savannah and caatinga excluded.
2. IBDF, 1983; effectively planted until 1981.
3. Approximately 85% belongs to the Legal Amazon.
4. Area of approved reforestation projects up to 1986 according to Morães et al., 1988 (citing IBDF), corrected for the usual difference between approved and effectively implemented reforestation projects.[5]
5. Morães et al., 1988 (citing IBDF, 1988).
6. Vantomme & Peixoto, 1985.

The southern timber industry adapted to the scarcity of raw materials from local sources, after a crisis during the years 1979/80. In 1986, the timber sector in the South processed 22,737,000 m^3 of roundwood from natural forests and 4,161,000 m^3 from *Pinus* plantations (Morães et al., 1988).[6]

5. Between 1967 and 1987 reafforestation was encouraged by fiscal incentives. It was allowed to deduct 17.5% (central and southern Brazil) to 25% (North and Northeast) from income tax, provided it was invested in reforestation. It is generally acknowledged that there is a difference between the area of approved reforestation projects and the area which has been effectively planted, due to unsuccessful operations, death of trees, lack of silvicultural treatments or lack of fulfilment of the established contracts. For the Mid-West this difference amounted to 13.8% until 1981 (IBDF, 1983). This percentage is used in order to correct for the area of approved projects until 1986.

6. Material from *Eucalyptus* plantations (54.3% of the total plantation areas) is principally used as fuelwood for use in bakeries, potteries and cement mills, for the production of charcoal to be used in steel mills, pulpwood, poles, and as raw material for fibreboard and particle board. *Pinus* (32.4% of total plantation areas) is used for pulpwood, particle board and sawnwood (IBDF, 1985; Vantomme & Peixoto, 1985; Nahuz, 1988). According to the Brazilian Association of Timber Producers (ABPM), only 6% of the material from *Pinus* plantations is used for mechanical timber processing (Morães et al., 1988).

Local forest reserves provided 36.4% of all raw material from natural forests. The remaining roundwood was imported from other regions, principally the North. This created an important market for Amazonian hardwood species.

Another stimulus for timber production in the Amazon region that originated from the increasing scarcity of raw materials in southern Brazil, was the migration of sawmills and timber companies. As will be seen in the next chapter, a substantial part of the Amazonian timber industry finds its roots in the South. In the next sections we will highlight other changes at national level that made the exploitation of Amazonian forest resources more attractive.

2.2 Policy measures to stimulate forestry in the Amazon

As we have seen in the previous section, one of the reasons for the southern timber producers avoiding the Amazon in the past was the lack of governmental support for timber production. In their eyes, too little attention was paid to the timber industry compared with the incentives given to cattle raising and farming. However, there has been some effort to encourage forest exploitation in the Amazon region and we will look at this more closely in this section. We will consider the first attempts made to acquire information about Amazonian wood resources, the Pandolfo proposal to demarcate production forests and the recommendation of Schmithüsen to issue risk contracts.[7]

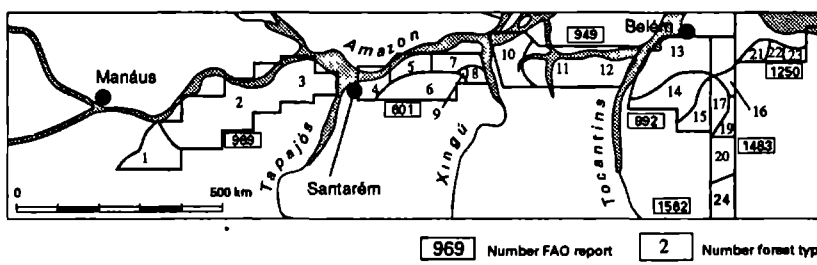
2.2.1 The first steps

During the 1950s, the first initiatives were undertaken to acquire more information about the Amazonian forest resources and the properties of wood species. In 1954, the Brazilian government concluded an agreement with the Food and Agricultural Organization (FAO) of the United Nations to make a forest inventory in the region. The expedition, led by the Dutch forester Hammis Heynsdijk, studied a strip of an average of 100 km width and 1,700 km length along the Amazon river between the Maracassumé river in the state of Maranhão and the Madeira river in the state of

7. Initiatives in the field of forest management for the sustainable production of timber will be dealt with in chapter 5.

Amazonas (Map 2.2). For each of the 24 forest types which were mapped out, the number and volume of timber species, the number of trees per hectare and the diameter of the trees were calculated.

Although this was for the first time in history that an inventory had been made of a representative part of Amazonia, its impact was negligible. For a long time, the report produced in twelve volumes circulated on a limited scale and only in FAO headquarters. It was hardly disseminated within Brazil where a Portuguese version without the original maps and lists of wood species was published in 1973, almost 15 years after the original publication.[8] Some indirect influence has been noticeable in official documents, such as the Pandolfo proposal from 1974, where some of the FAO recommendations reappeared (SUDAM, 1973; Pandolfo, 1974; Valverde, 1980; Nascimento, 1985).



Map 2.2 FAO inventory of the Amazon forest (based on SUDAM, 1973).

Two other initiatives to encourage forestry and technological wood research were the establishment of the National Institute for Amazon Research (INPA) in Manáus and the Technological Wood Centre (CTM) in Santarém in the 1950s. At the INPA, silvicultural research and the technological analysis of wood species have been important activities. The CTM was created to carry on industrial research and labour training. The experimental station Curua Una for silvicultural research, located 110 km from the city, is affiliated to it. Both received financial and technical support from the FAO (SUDAM, 1980; Nascimento, 1985).

8. The original documents were published between 1957 and 1960.

2.2.2 *The Pandolfo proposal*

The report which probably played the most prominent role in the discussions about forest policy for the Amazon is Clara Pandolfo's proposal to demarcate twelve production forests (*florestas de rendimento*) (Pandolfo, 1974).[9] According to this proposal, timber companies could acquire concessions to exploit these forests on a sustainable basis.

Her proposal was actuated by the anticipated expansion of timber exploitation in the Amazon and the primitive state of the timber sector. She expected a rush of domestic and foreign timber companies to the region, due to the depletion of forest resources in southern Brazil, Africa and Asia. In her eyes the real vocation of Amazonia is forestry. However, a number of factors held back the development of the timber industry.

Primitive manual extraction methods confined the exploitation areas to the river margins and resulted in low productivity[10], transport losses and irregular supplies to the wood-processing industry. Reforestation by timber companies was deficient and control of it by government institutions inadequate, due to the dispersion of logging operations and the lack of personnel and financial means.[11] Timber processing industries were inefficient because of poor equipment, irregular roundwood supplies by intermediaries and a highly selective use of timber species. Commercialization was hindered by the poor quality of timber products, the lack of promotion and because many Amazonian wood species are, as yet, unknown on the market.

For Pandolfo the solution was to concentrate logging operations in twelve areas and have them undertaken exclusively by large, modern, vertically integrated companies, which were to be engaged in all the phases from extraction to commercialization. These exploitation reserves, 392,530 km^2 in extent, were to be located near navigable watercourses in areas with a 'clear forestal vocation' and a high density of commercially valuable

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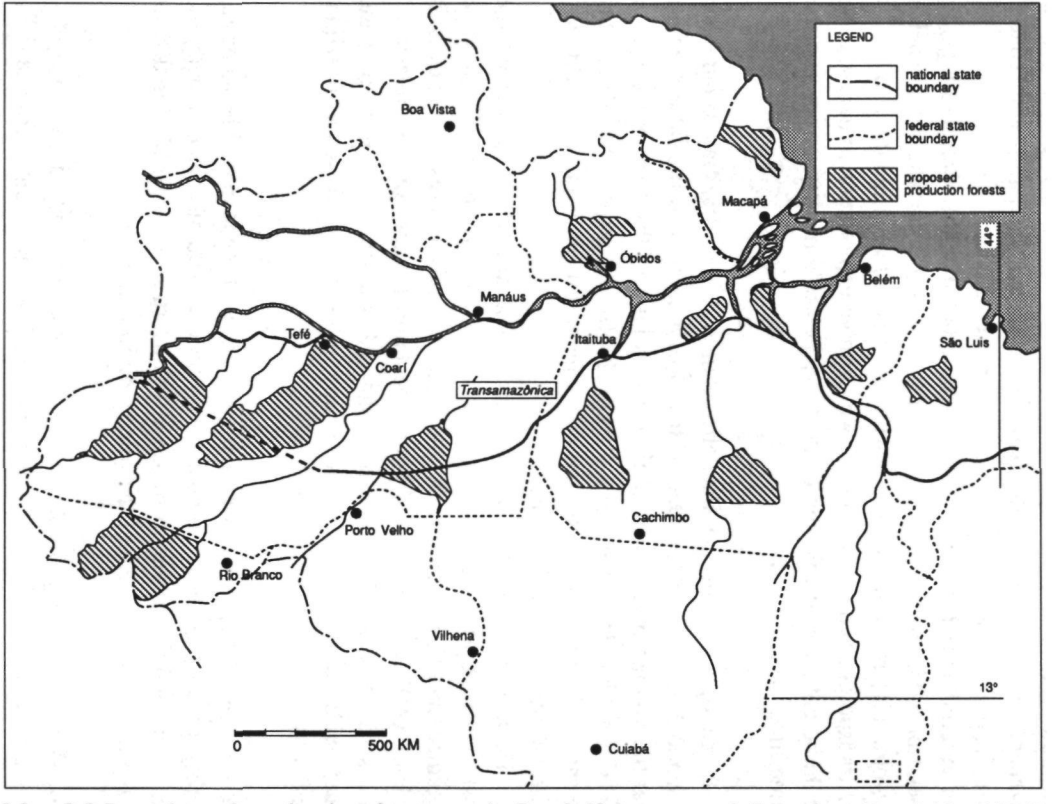
9. Clara Pandolfo was director of the Department for Natural Resources of the Superintendency for the Development of Amazonia (SUDAM).

10. The Pandolfo report mentions a productivity of 0.5 m^3 wood per man-day in the case of manual felling with an axe and non-mechanized transport; 17 m^3 when a chain-saw is used and 50 m^3 per man-day when both extraction and transport are mechanized.

11. At the time, the rules for timber companies focused on reforestation, as this was considered the best way to regenerate the forest after logging.



Map 2.3 Location of production forests as in Pandolfo's proposal (based on Pandolfo, 1974).

timber species. Their location was not allowed to be the same as that of indigenous reserves or colonization areas (Map 2.3).

The administration and management of the production forests, the selection and control of the concessionaires and the promotion of regeneration was to be in the hands of a mixed company, with shared participation between the state and private companies.

According to Pandolfo, this plan would facilitate the control of logging operations. Through the selection of technologically advanced companies it would also result in the modernization of both the extraction and the transportation of timber. In this way, timber exploitation in the Amazon could be both sustainable and competitive in world markets at one and the same time.

A fierce opponent of the Pandolfo plan was the Brazilian geographer Orlando Valverde (1980). One of his objections was to the false premise that the volume of commercial timber in forests of the *terra firme* was to be 178 m^3/ha. Data from the RADAMBRASIL project on which this premise was based, indicate that this volume ranges from 76 to 190 m^3, with an average of 113 m^3/ha.

He also criticized the fact that the public sector would bear all the costs, whereas private companies could keep all the profits. He also doubted whether any private company would invest in a mixed forest company with at least a 60% participation of governmental institutions (a 'bottomless pit' in his view) or whether large multinational companies would respect the rules with regard to reforestation any more than did small Brazilian sawmills.

He was not too hopeful about the improvement of the responsible agencies' ability to control these companies as they structurally lacked both the personnel and the means of transport to undertake such a task. Finally, he was very pessimistic about the role of multinationals:

> 'Why should large multinational companies suddenly decide to be overcome by charitable feelings and want to 'help' Brazilian forestry? (...) The facts are these: as there are very few of these tropical forests left, the multinationals come here, bringing their 'technology' to destroy the Amazonian forest, too. If their intensive techniques would really be so 'rational', the tropical

> forests of Africa and Asia would not be in the process of disappearing. More than technology, what Brazil in this case would import would be the destruction of the environment and the exploitation of human labour' (Valverde, 1980:32, translation by the author).

Valverde's criticisms can both be softened and complemented. On the one hand, it was not Pandolfo's intention that the public sector would bear all the costs as Valverde suggested. On the contrary, her proposal was to create a reforestation fund to which timber companies would contribute according to their production.

It is also questionable as to whether large (multinational) companies would really infringe the regulations on reforestation and forest management any more than would the small sawmills as their margin of profit would allow more expenditure in this regard than small sawmills could afford.

On the other hand, Pandolfo's preference for large, technologically advanced and vertically integrated companies appears to be somewhat naive. One of her arguments in their favour is that these companies would cause less ecological damage. A curious conclusion after having established that their range of action is much wider and their productivity a hundredfold compared to traditional manual logging.

Another weakness in her proposal is that it says nothing about what should happen with the numerous lumbermen, intermediaries and small producers for whom there is no place in the plans.

Finally, it seems doubtful as to whether timber companies would be willing to displace their activities to the production forests, as it would imply more costs in the development of management plans and more state supervision. The report also left the question of how to control and penalize illegal logging outside the production forests unresolved.

It is not clear why Pandolfo's proposal has never been implemented. One factor may be the criticisms of opponents such as Valverde. Nascimento (1985) suggested that the plan was probably premature and, in some respects, too difficult to implement. Another factor could be the poor relations between the SUDAM and the IBDF, as the SUDAM was acting within the sphere of competence of the IBDF with this proposal for a forest policy. Another source of disagreement between the two agencies was the

fiscal incentives conceded by SUDAM for cattle-raising which seriously threatened the forest resources (Nascimento, 1985).

Despite the fact that the proposal is occasionally relaunched, there are no signs that it will be implemented in the medium term.

2.2.3 Risk contracts: the Schmithüsen report

A plan that raised even more commotion was the report written by the Norwegian FAO-expert Schmithüsen.[12] He visited Brazil in 1977 at the invitation of the IBDF, the FAO and the United Nations Development Plan (UNDP). In his report, he complained that Brazil, unlike other tropical countries, did not grant temporary concessions to exploit forest resources in the public domain. In his view, the irregular supplies from the Amazon and the lack of investment by large and modern enterprises were due to the existing structure. He recommended a system of 'Forest Utilization Contracts' (*Contratos de Utilização Florestal*) for selected forest areas under federal government control, to be issued for a short, medium or long term period of 1-5, 5-10 or 10-20 years, respectively. A qualitative distinction could be made between (a) 'exploitation contracts' to selectively extract the wood with commercial value; (b) 'wood harvesting contracts' to remove all timber and (c) 'contracts of forest control' to reafforest after complete clearance. All these variants were referred to as 'risk contracts' (Valverde, 1980).[13]

According to this plan, the government would conduct forest inventories to assess the standing timber. On the basis of these inventories, interested companies could develop proposals for the industrial utilization of wood resources. Subsequently, the selected companies were to develop more detailed exploitation schemes with governmental support and they would then negotiate about the terms of the utilization contract.

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12. Schmithüsen, F. Contratos de utilização florestal com referência especial à Amazônia brasileira, Brasília: IBDF/PNUD/FAO/MA (PRODEPEF), 1978. Summarized in Valverde (1980:22-25).

13. The term 'risk contract' finds its origin in the Brazilian oil industry where it denotes a concession in areas where geological surveys indicate favourable conditions for finding oil. The oil company takes the risk, however, of discovering that exploitation is not economically viable. The term does therefore not apply to timber exploitation in precisely this sense as forest inventories indicate how much timber can be found.

The definitive contract should establish that the timber company be responsible for the logging operations, which should be undertaken under specific conditions and supervised by the government. The company would have to pay according to the species and the volume of the wood harvested. It should also contribute to the expenses of the public sector for forest inventories, administration, supervision and forest management (Nascimento, 1985).

Although Schmithüsen acknowledged that the danger inherent in his plan was that the forest might be depleted if the IBDF were not reinforced in order to control the companies, he attributed the following advantages to it:

- timber companies would not need to invest in land property;
- the government would not need to invest in the timber industry;
- the reliable supply of raw materials in the long term would allow for intensive exploitation in large units, so that large multinationals with the ability to conquer foreign markets could be attracted;
- the economic stability of companies with long term contracts would bring about the stability of communities and enhance rural development;
- the government would benefit from the taxes on produced timber;
- long term utilization contracts would bring about more equity among the producers, as they would no longer invest in the acquisition of forest land. (Valverde, 1980:24).

The Schmithüsen report, even more than the Pandolfo proposal, is directed towards the attraction of multinational companies. Opponents of his plan therefore concluded that the Amazonian forest would be 'auctioned and sold out' (A Provincia do Pará, November 20, 1979) and would share the fate of the depleted African and Asian forests.

The plan was also criticized by organizations of timber producers from southern Brazil, who had not been consulted by Schmithüsen. Their opinion was that national companies were by-passed to the benefit of multinationals. They also questioned whether the disadvantages of the plan, such as unbridled deforestation and the lack of reforestation had been sufficiently examined (ABPM, 1978).

The Schmithüsen plan has never become official policy. Some elements though, can be found back in the management plan for the Tapajós National Forest in the state of Pará, which will be described in Chapter 5.

2.2.4 The programme of entrepôts for export timber

Another initiative of the IBDF for stimulating timber exploitation in the Amazon region has been the Programme of Entrepôts for Export Timber (PROMAEX), initiated in 1982. The purpose of this programme was to increase Brazil's share of the world market for tropical hardwood products which in spite of its having the largest reserve of tropical rain forest in the world, was under 1%. One of the reasons for this limited share was seen in the fact that most of the wood products came from small sawmills with poor quality products and which were too small to operate on international markets.

To enable small producers to export their products and to guarantee regular good quality supplies to the customers, the PROMAEX programme was designed to establish five entrepôts in the Amazon region. The entrepôts were planned in Santarém (Pará), Porto Velho (Rondônia), Breves (Pará), Manáus (Amazonas) and Boa Vista (Roraima). The intention was that each entrepôt should provide various services, including the storage of sawnwood and the upgrading (reprocessing, preservation treatment, and packing) of wood products to export quality, transportation to the nearest port and ship chartering. Beside these services, the IBDF intended to operate training courses for sawmill managers, classifiers and packers; conduct market surveys and promote Amazonian wood products in foreign countries (IBDF, 1982; Nascimento, 1985).

The first entrepôt was opened in 1984 in the city of Santarém. This city was selected for the pioneer function because of its port facilities, the availability of communication and energy facilities, the presence of banks and the potential of servicing a large region (the north of Mato Grosso, the environs of the Transamazônica and the Altamira region and the Tapajós National Forest).

The Santarém entrepôt operated for only two years and was closed down in 1986 when the participating state company COBEC, the Brazilian Export and Trade Company was dissolved. The IBDF alone was not allowed to engage in commercial transactions and the programme was discontinued. To benefit from the buildings in Santarém, sawmills can now

use them as storage space for wood products.[14] Only a few large companies, which also export their products without the help of any programme, do so. The services, training and marketing facilities which were originally planned have been shelved.

The entrepôts outside Santarém have never been established. The programme's objectives of increasing participation by small producers in the export of wood products, expanding timber production in the period from 1982 to 1990 by 7,800,000 m^3 and increasing employment in the timber industry by 13,000 jobs, are very far from having been achieved.

2.3 Regional development plans

Reviewing government efforts to stimulate timber production in the Amazon region, we must conclude that these have been too weak to explain the considerable increase in logging and wood-processing activities. The significance of these efforts, if any, lies in the increased information about Amazonian wood species and their properties and the promotion of new species on foreign markets. To explain the conditions which favoured the growth of the Amazonian timber industry we must turn to the general development efforts for the region.

2.3.1 The first efforts to develop the Amazon region

Until the 1950s state intervention in the Amazon was restricted to the rubber economy. The first intervention dates back to 1912, when rubber exports collapsed as a result of competition with cheaper Asian latex. A new federal organization, the Superintendency for the Defence of Rubber (SDB) was charged with the restoration of Brazil's position on the world market.

The state intervened a second time during the Second World War when Brazil and the United States had concluded the Washington Accords. Brazil was exempted from import duties in exchange for supplying the strategically important rubber at low prices to the United States. To give a

14. One of the causes of the poor quality of many timber products from small sawmills is the inadequate storage facilities. Due to the influence of weather conditions (humidity, heat) the quality of sawnwood rapidly deteriorates.

financial impulse to the rubber economy, the government created the Rubber Credit Bank.

If it had not been for the concern that foreign countries would claim Amazonia and its vast resources, the interest of the Brazilian government might have been restricted to these aspects for a much longer period. However, the fear rose that the Brazilians would lose their sovereignty in Amazonia when, after the Second World War, plans were made to establish an international research institute in the region financed by the UNESCO (Nascimento, 1985). In the 1950s, for the first time in history, the Brazilian government began to show an interest in developing the Amazon region as a whole and involving more resources than rubber alone.

In 1953 a new federal organization was created to stimulate the economic and social development of Amazonia: the Superintendency for the Amazonian Economic Valorization Plan (SPVEA). It produced some regional development plans, but these were unsuccessful, because of inadequate information about the region, over-ambitious objectives and the bureaucratic character of the organization (Poelhekke, 1984; Nascimento, 1985; Miranda Neto, 1986). Nevertheless it was in this period that the foundations were laid for the increase of logging and wood-processing activities.

One of the most important impulses in this context was the construction of the Belém-Brasília highway (2,100 km) which was begun in 1957. Until this and other highways were constructed, only those parts of the forest could be exploited which were accessible by way of rivers. Now, new forest wood stocks were opened up and it became easier to penetrate the forest and to transport the logs. The Belém-Brasília highway also became the first overland connection between the Amazon region and Brazil's economic and political centre in the Southeast, thereby linking the enormous source of tropical hardwood in the North with the wood-processing industries and the market for timber products in the South. Even today, large concentrations of sawmills can be found along this highway. The most striking example is Paragominas in the state of Pará, a little town where more than 300 sawmills can be found. The impact of such roads on the timber industry could also be observed several years later in Rondônia

along the Cuiabá-Porto Velho road, where logging activities boomed after the improvement and asphalting of the road during 1981-1985.[15]

Efforts to open up and develop the Amazon region were intensified after the military coup of 1964. Geopolitical motives, such as extending political prestige and national sovereignty in the northern periphery, and economic ones, such as the utilization of the region's natural resources to improve Brazil's balance of payments and its overall economic growth, encouraged the military to accelerate the integration of the Amazon region into the national economy (Kleinpenning, 1990). It was since then that the industrial wood sector expanded rapidly.

An ambitious programme to occupy and develop the frontier areas of the region in particular was launched by the first military president, Castello Branco (1964-1967). It became known as *Operação Amazônia*. The economic valorization plan for Amazonia was adapted[16] and the agency responsible for its implementation, the former SPVEA, was transformed into the Superintendency for the Development of Amazonia (SUDAM). This agency had to elaborate, coordinate and implement regional development plans. It was also charged with the evaluation and selection of investment plans presented by entrepreneurs who wanted to benefit from tax incentives.

2.3.2 Fiscal incentives

Until the 1970s, the principal means of realizing the incorporation of the Amazon region was the tax incentives programme initiated in 1963. Initially the programme was restricted to Brazilian industrial firms who could be exempted from the payment of up to 50% of their federal income tax, provided that they invested the same amount of money in Amazonia. By 1965 one third of these tax-financed investments was in wood industries (Nascimento, 1985).

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15. The 1,456 km long road from Cuiabá to Porto Velho (the BR-364) was constructed in 1965 but its impact was particularly felt after the launching of the regional development programme for the Northwest (POLONOROESTE). A large part of the programme's budget (57%) for the period 1981-1985 was earmarked for the improvement and asphalting of the road (Fearnside, 1987:46).

16. See Poelhekke (1984:116-117) for a short summary, based on Cardoso, F.H. and G. Mueller. Amazonia; expansão do capitalismo. São Paulo: Brasiliense, 1977.

Table 2.2: Tax subsidies per economic sector (up to March 1989)

Sector	Number of projects[1]		Tax subsidies (US $ 1000)	
Cattle-raising	667	59.8%	801,700	41.4%
Industries	328	29.4%	838,158	43.2%
Basic services[2]	39	3.5%	80,886	4.2%
Agro-industry	47	4.2%	133,382	6.9%
Tourism and fishery	34	3.1%	83,286	4.3%
Total	1,115	100.0%	1,937,412	100.0%

1. Until August 1988.
2. Mostly transport and communication.
Sources: Browder, 1986:103; SUDAM/DPO/DAL

Table 2.3: Approved tax subsidies (1983-1987)

Sector	Number of projects	Total investment (US$ 1000) (a)	Tax subsidies (US$ 1000) (b)	% (b/a.100)
Cattle-raising	277	1,033,342	542,002	52.5
Timber industry	23	243,901	109,403	44.9
Other industries	103	1,764,876	753,262	42.7
Basic services	11	143,202	30,998	21.6
Agro-industry	20	386,397	171,934	44.5
Tourism & fishery	13	261,161	94,817	36.3
Total	447	3,832,879	1,702,416	44.4

Source: Annual reports SUDAM/DPO/DAI 1983-1987.

In 1966 the programme was further extended to multinational companies and other economic activities, such as agriculture, cattle-raising and the exploitation of natural resources. Nevertheless, timber exploitation and the collection of other forest products have never had much priority. The government preferred labour-intensive activities or activities which stimulated the occupation of the most remote and less developed parts of Amazonia, and activities which produced goods and services for export or import substitution, preferably based on regional raw materials.
As illustrated in Table 2.2, SUDAM released a total amount of US$ 1.9 billion of tax funded subsidies to 1,115 projects in the period from 1965 to

1989. Most of these subsidies were invested in industry (43.2%) and livestock-breeding (41.4%).

SUDAM's reports do not specify the amount of funds allocated to the timber industry. To evaluate the position of the timber industry in the totality of subsidized investments in Amazonia, we analysed the projects which were *approved* between 1983 and 1987.[17] As Table 2.3 shows, 12.7% of the approved subsidies for industrial projects during this period were granted to wood-processing industries. Of all approved tax subsidies only 6.4% were assigned to the timber industry. As sector priorities did not change as compared with the preceding period, it may be assumed that these figures are representative of the total period. During the whole SUDAM period until 1989, the number of new enterprises established with the help of tax subsidies amounted to 59 at most.[18] This is only a fraction of the thousands of sawmills which had mushroomed all over the area.

It is not only because of these low figures that it is questionable as to whether tax incentives really had influenced the number and the volume of investments in the timber industry. As only large companies with the status of limited liability company *(Sociedade Anónima)* could be considered for fiscal facilities[19], the majority of sawmills are too small to benefit from them. In our survey, for example, only 14% of all wood-processing industries had the legal status required to apply for tax incentives. Only half of these firms received tax financed subsidies; most of them primarily for livestock breeding (three out of five). In these cases, sawmills are secondary

17. From the data available it is not possible to calculate what part of the total amount of subsidies paid after 1965 was allocated to the timber industry. In the annual reports of SUDAM, wood processing industries only appear in the tables relating to approved subsidies. These are not the same as the total of subsidies paid, so the totals of Tables 2.2 and 2.3 cannot be compared. Moreover, in 1989, annual reports were only available for the years 1983 to 1987. Average exchange rates were calculated on the basis of data from Banco do Brasil. As SUDAM does not correct its data for inflation, we must be very cautious about the significance of absolute values.

18. It is difficult to obtain consistent information on the number of wood-processing industries established with tax subsidies. The Administration of Incentives Department of SUDAM provided both the figure of 52 (up to 1988) and 40 (up to 1989), while Browder (1986:106) gives 59 new production units up to 1983, based on information from the same department.

19. Large companies are supposed to involve relatively lower overhead expenses, a lower degree of risk of failure, and to generate more employment.

investments which provide the *fazenda* with timber for fencing, housing and stables. All the sawmill owners in this region who benefited from the tax programme considered it as a 'windfall' rather than a primary pull factor for investment in the Amazon region.

As we will see in the next chapter, more important motives for investing in the region are the availability of cheap land and the abundance of roundwood. Only in the case of the large timber companies that we visited in Belém had the tax incentive programme a more pronounced impact on the investment decision. Twenty-five per cent of the non-Amazonian capital owners of these large firms confirmed that tax incentives were their principal motive for investing in the Amazon region. This confirms that the influence of the fiscal policy is restricted to such large companies. But within this group, too, the most frequently mentioned motive for investing in Amazonia is the abundance of raw materials. Most of them would also have been established in the Amazon even without the fiscal facilities.

More doubts about the effects of the tax incentive programme have been raised by Browder (1986), who studied the timber industry in the state of Rondônia. One of his reservations concerns the high level of public money involved in total investments. He calculated that only 45% of the total value of tax financed investments in wood processing consisted of private capital, the remainder being provided by government funds. By 1989, this percentage had risen to 54%.[20] This means that the objective of the fiscal policy attracting private capital had only limited success as about half of the investments were financed by the state through tax subsidies.

Another questionable point is the average installation costs of the tax financed sawmills which amounted to US$ 3.2 million. In Browder's view this must have been heavily overstated as the average value of the sawmills in his study amounted to US$ 167,000. The best equipped sawmill in his survey was valued at US$ 2.2 million. Furthermore, he concluded that 61% of all investments had been realized in sawmills which had produced simple low-valued sawnwood, using inexpensive equipment and employing few workers.

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20. According to data provided by the *Departamento de Administração dos Incentivos*, up to 1989 the SUDAM granted tax incentives to 40 wood processing industries with a total amount of US$ 282,717,535. Total investments by these firms amounted to US$ 615,481,934.

He also pointed to the misuse of public funds. As subsidies were allocated on a project basis, it was possible to obtain multiple grants for the same company.

Finally, he stated that the tax programme had done little to promote stable settlement or employment in frontier areas, as most of the wood-processing industries had become established in traditional production centres such as Belém, Santarém and Portel.[21]

In the light of the fiscal policy's limited impact on the timber industry and considering the location pattern of the sawmills, we have to seek the main reasons for the growth of the Amazonian timber industry in the combination of an ambitious road construction programme and the colonization policy started after 1970.

2.3.3 Road construction and colonization programmes

During the 1970s, regional policy changed, as the Brazilian government saw itself confronted with serious social problems in northeastern Brazil. Unequally distributed landownership and severe droughts had produced a disastrous situation for the rural poor. Land reform was necessary, but the military tried to avoid it by presenting their Plan for National Integration (PIN) as a way of solving the problems of the northeastern region. The Amazon region was to be opened up to create the space which the landless peasants from the Northeast lacked. The device was 'to bring people without land to a land without people'.

The Transamazonian highway was constructed to connect the two regions. Along this highway a colonization scheme was designed to resettle 100,000 rural families from the Northeast within five years. Apart from the Transamazônica (4,918 km) the road from Santarém to Cuiabá (1,500 km)

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21. The concentration of tax financed investments was recognized by the Brazilian government. An attempt to attract investors to the eastern Amazon was undertaken by the creation of a free trade zone in Manáus in 1967. Companies selected for establishment in this zone were exempted from import and export duties and could obtain fiscal facilities. These benefits have been extended afterwards to other parts of the eastern Amazon. This resulted in an increase in the number of wood processing industries that benefited from the programme. In 1988, 95 out of 346 enterprises (27.5%) which benefited from the incentives of the Superintendency of the Manáus Free Trade Zone (SUFRAMA) were wood processing industries. Two thirds of them were to be found in Rondônia.

was also planned in the same period.

Although the road construction programme and colonization schemes had never been directed towards the timber industry, they gave an important impulse to wood extracting activities. In the case of the Belém-Brasília highway, we have already noted the increased accessibility of the forest and the integration into the national market for wood products in the South. The new roads also offered better connections to important wood-processing centres such as Belém and Santarém.

The Land Redistribution Programme (PROTERRA) associated with the colonization programme, enabled enterprises to gain access to large amounts of land at low cost. Although not much data are available on this topic, there are some examples of extremely large landholdings by timber companies (see Chapter 6). Plywood industry MANASA Ltd. in the state of Amazonas, not only owns an area of 4,111,538 ha, but it also is the largest private landholder in Brazil.[22]

The colonization of Amazônia also stimulated the establishment of sawmills which did not have their own forest land. Although much wood is burned when the forest is cleared for agricultural activities, there are many peasants and *fazendeiros* who first sell the most valuable species, as will be seen in Chapter 4. In this way large landholders finance the transformation of forest into pasture and peasants broaden the basis of their subsistence, as income from agriculture is low and uncertain.

Apart from the increased supply of roundwood, road construction and colonization have also augmented the supply of cheap labour. The roads stimulated an enormous flow of landless peasants from the northeastern and southern parts of Brazil. Many of these migrations, either to official colonization projects, or to spontaneous settlements, ended in complete failure. Lack of technical and financial support, different conditions for agriculture in the wet tropics as compared with the dry Northeast or the more temperate South, the absence of health care and educational facilities and the poor condition of the roads - which hindered the marketing of the products - are some of the factors which explain this failure.[23] The Pastoral Land Committee (CPT), an organ within the Brazilian Catholic church engaged in supporting the victims of land conflicts, reaches the

22. Taken from a document submitted by the Brazilian Ministry of Land Reform and Agricultural Development to the National Constituent Assembly.

23. For a more detailed evaluation of the colonization policy, see Kleinpenning (1977).

following conclusion about the colonization programme:

> 'Although these projects represent a failure for the peasants, they were successful for the government and the class that it represents. There are now vast areas deforested for the planting of grass, and cheap labour for the large industrial and mining projects' (CPT-Região Norte, cited in Souza, 1988:25, translated by the author).

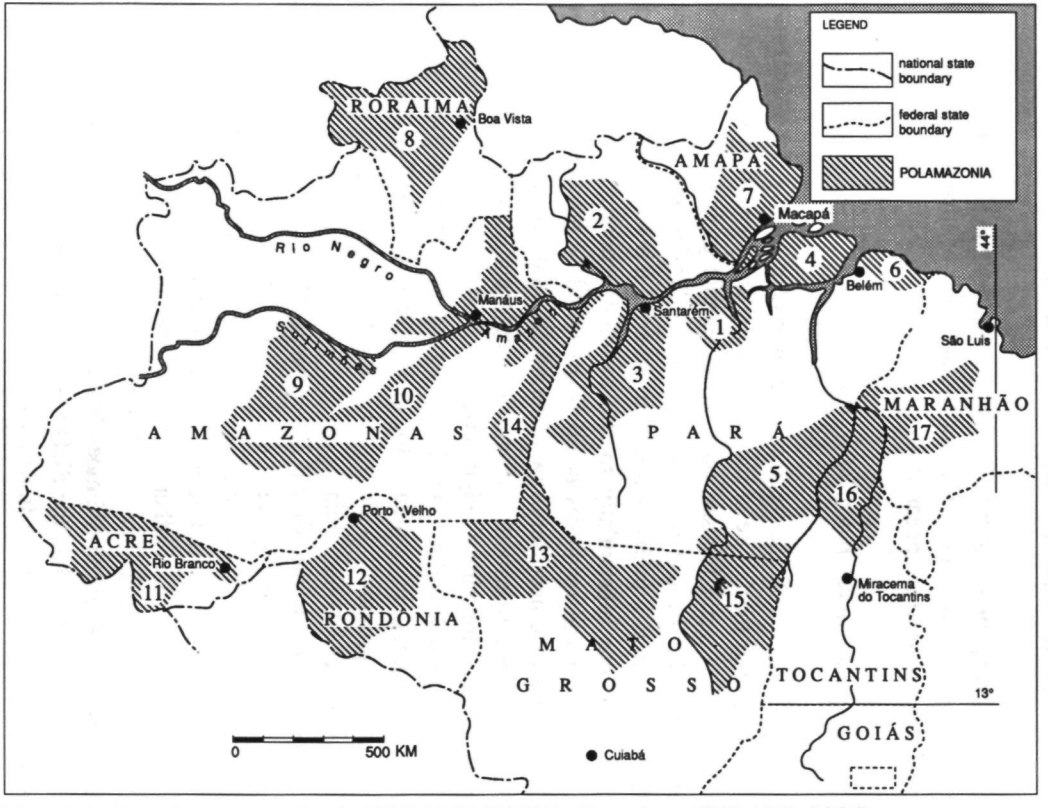
The timber companies also benefited from this cheap labour. The supply of skilled labour is still a problem, but the shortage of unskilled labour has virtually completely disappeared.

2.3.4 Large-scale development after 1975

The social aspect of the regional development policy for Amazonia disappeared after the failure of the colonization schemes, to be replaced by a policy which again focused on rapid economic growth. In the Second Development Plan for Amazonia (PDA II - 1975-79) the region was no longer regarded as a problem area, but rather as a resource frontier which could contribute substantially to the national economy. The enormous potential of natural resources could be exported or provide the southern industries with the necessary raw materials. Both domestic use and export would contribute to a better balance of payments: either by substituting imports, or by supplying foreign currency.

The Second Development Plan assigned an important role to large private companies. In exchange for their investments in Amazonia, they were to be provided with fiscal facilities, infrastructure, research, information and labour-training.

A new aspect in the Second Development Plan was the programme to concentrate the development efforts in fifteen development poles (POLAMAZONIA). These areas were to be selected on the basis of their special suitability for agriculture, livestock breeding, mining, hydroelectric plants or exploitation of other natural resources. Four development poles were explicitly designated for timber exploitation: Pré-Amazônia Maranhense, Acre, Juruá-Solimões (Amazonas) and Amapá (Map 2.4). In connection with this plan, the SUDAM also published the Pandolfo report mentioned in Section 2.2.2. In practice, regional planning activities focused on the expansion of cattle ranches, the construction of hydroelectric plants



1 Altamira
2 Trombetas
3 Tapajós
4 Marajó
5 Carajás
6 PRONORPAR
7 Amapá
8 Roraima
9 Juruá-Solimões
10 PRONAM
11 Acre
12 Rondônia
13 Juruena
14 Aripuanã
15 Xingú-Araguaia
16 Araguaia-Tocantins
17 Pré-Amazônia Maranhense

Map 2.4 Development poles in POLAMAZONIA (based on SUDAM, 1986).

and the implementation of large mining projects. Examples are the Tucuruí dam, the construction of which started in 1974, and the Trombetas aluminium complex which is the result of an agreement between the Brazilian and Japanese governments signed in 1976.

There was no specific development plan for the Amazon region covering the first half of the 1980s. The programme for agricultural and mining poles remained operative during this period. The national development plan for the years 1980-1985 (PND III) expressed some caution about an unrestricted occupation of the Amazon region. The main objective continued to be the occupation and integration of the area, but - at least on paper - natural resources should be exploited in a sustainable way, with respect being shown both for the ecological balance and the indigenous population (Presidência da República, 1981).

In 1986 a new development plan for Amazonia was launched (PDA I - 1986-89) which was the first after the military dictatorship. It evaluated and heavily criticized previous development efforts and their results. It admitted that insufficient regard had been paid to the ecology of the region. The new infrastructure and financial supports had benefited only a limited group of people. POLAMAZONIA and the fiscal policy had far from achieved their target figures. Regional and income discrepancies continued to exist and were even sharper than before. Although some progress had been made in the infrastructure, the underdevelopment of the region continued and nothing had changed the primacy of the large centres of decision being in the South and Southeast. Where development did take place, it was restricted to a few urban centres and affected a minority of the population. The policy had failed to benefit the peasants, who had been left to their fate in ill-managed colonization projects (SUDAM, 1986).

The 1986 plan aimed at an acceleration of regional economic growth together with the maintenance of the ecological balance and a reduction of social disparities. As before, development efforts had to be concentrated in development poles. As far as the timber sector was concerned, the Pandolfo proposal to delimit production forests was launched once again.

The latest development plan for the Amazon region appeared at a time when Brazil was confronting one of the most severe and prolonged crises in its history. SUDAM's financial resources for implementing or coordinating development plans were being reduced each year. Interviews with representatives of SUDAM show that they considered PDA I to be

more a declaration of intent on how the government saw the development of the region than a real blueprint for action.

2.4 Summary

In this chapter we have looked at some factors at national level which could explain the rapid development of the Amazonian timber industry during the past few decades. In the first section we highlighted the successive depletion of abundant forest areas in other parts of Brazil as being the result of over-exploitation and clearings being made for agriculture and settlements. The Brazilian timber industry was concentrated in southern Brazil, close to the fairly homogeneous Parana pine forests. When these forests had almost disappeared completely, the southern timber producers had no choice but to substitute Amazonian hardwood for their traditional raw materials or to displace their activities to the North.

During the 1950s several research activities had provided more information about Amazonian wood species, their properties and potential end-uses. There had also been some initiatives to promote their use in domestic and foreign markets. Nevertheless, most government initiatives to promote forestry in the Amazon had had hardly any impact as most of the plans were either unsuccessful or not implemented at all.

The real conditions for the development of the Amazonian timber industry were provided by the road construction and colonization programmes. The roads opened up new timber stocks, facilitated exploitation and log transport and offered better connections between the exploitation and wood-processing areas. Colonization resulted in an increased supply of roundwood and labour. Tax incentives also played a limited role in the displacement of large companies to the Amazon.

The latest development plans have had little impact on the timber industry. This is only partly due to the economic crisis and the lack of financial resources. Development efforts have mainly been focused on large scale mining projects, hydroelectric plants and cattle-ranches.

3 The Amazonian timber industry in regional perspective

In the foregoing chapter we have considered the factors at national level that have created the conditions for the growth of the Amazonian timber industry. In this chapter we will look more closely at the general characteristics of the Amazonian timber industry as it has developed during the past few decades. In the first section we will look at the location and general features of the main production areas. In the second part of this chapter we will turn to the timber industry in our study area. We will describe the location, ownership, age, origin and production of the sawmills. The origin and exploitation of raw materials will be examined in the next chapter, and the employment aspects will be discussed in Chapter 6. The marketing of the products is the subject of Chapter 7.

3.1 Timber production in the Amazon: an overview

3.1.1 The historical development of industrial timber production

Timber has been exploited in the Brazilian Amazon since colonial times, albeit on a limited scale and restricted to areas accessible by river (Rankin, 1985). According to Almeida (1985), the development of Amazonian timber production at an industrial level can be divided into three periods. The first one, from the start of industrial development in the region at the end of the 19th century until the decline of the rubber economy in the second decade of this century, can be characterized as the extractive phase. During this period, timber production was secondary to the exploitation of rubber which was a more lucrative export product. Wood processing was partially oriented towards creating the conditions for rubber exploitation, such as the construction of public works, transportation and packaging. In addition, timber exploitation was strongly associated with the construction of houses, shipbuilding, furniture making and the manufacture of tools and consumer goods for the local market (da Silva, 1987). Mechanized production units were scarce. The tools most frequently used to fell the trees were the axe and the hand-saw to cut the logs into planks and other sawnwood.

The second phase covers the period between the collapse of the rubber economy in 1912 and the opening up of the region at the end of the 1960s.

Timber production turned out to be an alternative for the regional economy and for the capital owners who had previously invested in latex production. Producers of boxes to transport rubber changed over to the export of valuable timber species such as cedar and mahogany. The timber industry expanded and diversified; equipment and production methods became more mechanized. Relationships between entrepreneurs, intermediaries and extractors were organized in such a way as to guarantee the appropriation of surplus generated by the 'workers of the jungle', as had happened previously with the rubber economy.

The period from the end of the 1960s onwards shows some substantial changes when compared with the previous periods. Encouraged by fiscal facilities and the creation of new infrastructure, the number of wood-processing industries increased rapidly. There had been a growing tendency to establish sawmills in rural areas along the newly constructed roads instead of in the traditional locations on the river margins in urban areas. Large-scale mechanized logging operations became more widespread. Wood processing became more and more oriented towards the cutting of logs into more easily transportable units of interest to extra-regional markets. It was the interests of southern and northeastern industries which to an increasing extent determined the production of timber in the Amazon region. Large timber companies were established in various parts of the Amazon region to buy the production of smaller production units in their neighbourhood. Thus, the production of these smaller sawmills was structured for the benefit of the parent company in the South or Southeast at the cost of the local furniture industry, naval construction, box factories and so on that had depended on the output of sawmills for their own activities.

The expansion of the Amazonian timber industry since the 1960s is shown in Table 3.1. The table indicates that the number of registered sawmills has increased from 194 in 1965 to 3,523 in 1988. One must bear in mind, however, that in reality the number might be even twice as high especially in the interior where many small sawmills operate without registration.

When Knowles (1966) made his inventory of the timber industry in the Amazon region, sawmills were concentrated in Belém (35%), the mouth of the Tocantins river and the city of Breves on the Marajó Island north of Belém (together 27%) and Manáus (9%). He also found a few establishments in the cities of Macapá (Amapá), Porto Velho (Rondônia), Boa Vista (Roraima) and Santarém (Pará). Timber production was restricted

to the main urban centres as the region was almost inaccessible. Transportation of both logs and timber products depended on having navigable rivers and on public services, labour, fuel and spare parts which were only available in the cities.

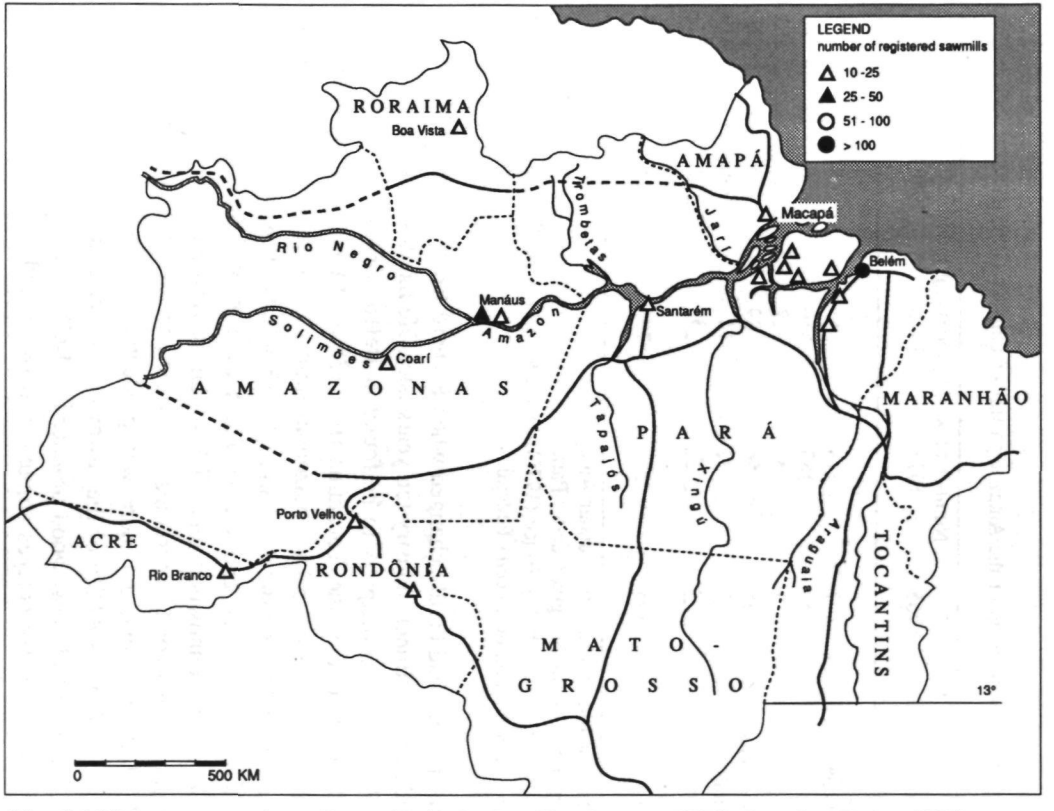
Table 3.1 Development of the Amazonian timber industry (1965-1988)

State	Number of wood-processing industries 1965	1973	1978	1980	1988
Amapá	7	18	**	60	72
Pará	147	183	510	866	1,546
Roraima	3	*	18	17	61
Amazonas	25	54	89	62	228
Rondônia	3	32	141	250	1,419
Acre	9	*	35	61	197
Total	194	287	793	1,316	3,523

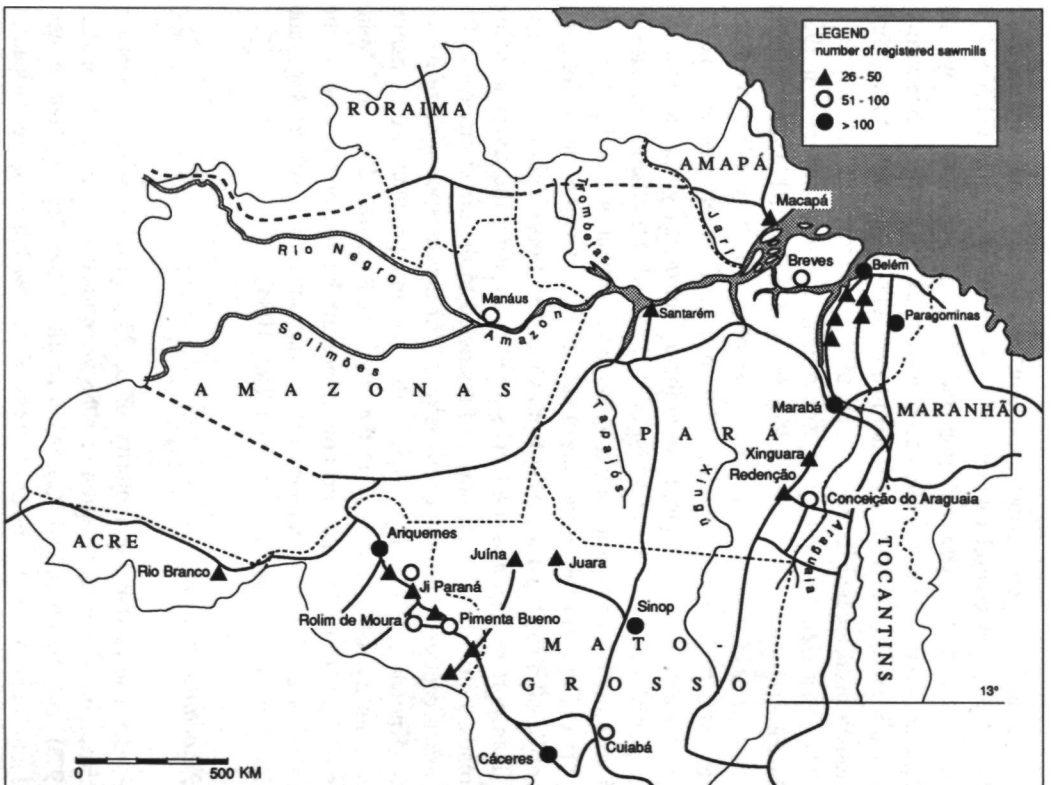
* Included in number given under Amapá
** Included in number given under Pará
Sources: Knowles (1971); Bruce (1976); Mercado (1980); IBDF (1982); Ministério da Fazenda/Secretaria de Receita Federal.

This pattern had hardly changed when Richard Bruce (1976) published his study on the timber industry ten years later. He mentioned the existence of 287 sawmills, principally to be found in Belém (36%), the Marajó Island and the mouth of the Tocantins river (28%), Manáus (19%) and Porto Velho (11%) (Map 3.1). Amazonian timber production was still heavily concentrated in the state of Pará, where not only 70% of all sawmills and 60% of all plywood and veneer plants were to be found, but where also 75% of all roundwood and 67% of all sawnwood was produced. The region's sawnwood exports also originated mainly from this state (89%). The further inland, the more was production directed towards the local market. Whereas 87.2% of the sawnwood production of the Marajó Island and 42.9% of all sawnwood produced in Belém were destined for foreign markets, these percentages amounted to 18.1% and 4.1%, respectively, for Manáus and Porto Velho.

Exploitation was highly selective with virola (*Virola* spp.) and mahogany (*Swietenia macrophylla*) accounting for almost half of the total



Map 3.1 Major concentrations of sawmills in the Brazilian Amazon (1973) (based on Bruce, 1976).



Map 3.2 Major concentrations of sawmills in the Brazilian Amazon (1988).

production. The six most important species accounted for 68% of the total production and 90% of the timber output was based on 23 species.

Another feature of the timber industry appeared to be its rapidly changing character. Sixty-one per cent of all sawmills had been established during the last five years prior to the year in which the study was realized (1973). Of the 194 sawmills which were present in the region in 1965, 119 had been dismantled between 1965 and 1973. The number of sawmills which were established after 1965 amounted to 212. A total of 26 sawmills (9%) had been displaced from southern Brazil and 34 sawmills (11.8%) had previously been located in another part of the Amazon region.

The most recent inventory of Amazonian forestry, published in 1984 by the Federal Rural University of Rio de Janeiro (UFRRJ, 1984), reflects the changes which occurred in the latest phase of the expansion of the timber industry. The most striking difference with earlier overviews is the heavy concentration of development in the timber industry in Rondônia and in southern Pará (Table 3.1 and Map 3.2). This indicates the importance of road construction and colonization to the development of wood-processing industries. The main concentrations of sawmills can now be found along the Belém-Brasília road and the road from Cuiabá to Porto Velho.

Transport of logs and products shifted from using the rivers to using the roads. In 1970 road transport was restricted to the direct environs of a few urban centres where road beds allowed for the transportation of heavy loads (Knowles, 1971). By 1984, both logs and products were mainly transported by road, especially in the states of Pará, Rondônia and Mato Grosso. Only in traditional and now minor production areas, such as the states of Amapá and Amazonas are a substantial part of the logs and products still transported by river (UFRRJ, 1984).

3.1.2 Location factors

Table 3.1 shows that the majority of 3,523 registered wood-processing industries in the northern region in 1988 were located in the states of Pará (43.9%) and Rondônia (40.3%). As a result of the development of new production centres in colonization areas, Pará now has to share its leading position as a holder of the largest number of sawmills. The state of Amazonas, whose share in the total number of wood-processing industries dropped from 12.9% in 1965 to 6.5% in 1988, cannot any more be regarded as one of the major production centres.

Reviewing the past and present location of the principal timber producing areas, we can conclude that the following location factors play a role in the timber industry:

1. *The availability of forest resources.* Not only is the presence of a forest area as such relevant but, in particular, the volume, density and distribution of species of commercial value and the diameter of the trees are important.
2. *Accessibility of the forests.* This not only includes the presence of roads or navigable rivers, but also juridical accessibility. In some areas, such as protected forests and indigenous reserves, exploitation is not allowed. In other areas no more public land is available and the opportunities for forest exploitation depend on the land-owners.
3. *Outlet facilities* or connections between the sources of raw materials and the market for timber products. If local demand for timber is low or absent and transportation to the nearest markets virtually impossible, wood will have insufficient economic value to be exploited. This point may well be illustrated by the high percentage of wood that is burned in colonization areas. In these instances, timber exploitation is only economically feasible for the most valuable species such as mahogany.
4. *Supply of a stable work-force,* not only in the quantitative sense, but also with regard to their skills.
5. *Availability of public and other services* necessary for production such as financial institutions, energy supply and availability of spare parts and fuel.

3.1.3 Other features of timber production in the Amazon

The majority of the 3,523 establishments in Table 3.1 are sawmills whose main products are planks, boards and beams. According to data from the UFRRJ inventory, the number of veneer and plywood industries in the Amazon amounted to 86 at the beginning of the 1980s. They were mainly to be found in the federal states of Pará (35), Mato Grosso (22) and Rondônia (19) (UFRRJ, 1984).

Most of the sawmills are small. Unfortunately, the 1984 inventory does not present the data about the production capacity of the sawmills in a

uniform way.[1] Hence, a comparative stratification of the production capacity in the various states is not possible on the basis of recent data. Data used by Mercado (1980) suggest that 65% of the sawmills in the Amazon region produce less than 5,000 m^3 per year and that only 7% of them have an annual output larger than 10,000 m^3. According to Browder (1986) these percentages amount to 77% and 9%, respectively. As both authors use data from registered firms only, they probably underestimate the share of the small or very small sawmills.

Table 3.2 Amazonian roundwood production by state (1989)

State	Roundwood from native forests m^3	%
Amapá	549,284	1.1
Pará	43,138,701	86.0
Roraima	37,273	0.1
Amazonas	626,011	1.3
Acre	309,734	0.6
Rondônia	2,255,352	4.5
Mato Grosso	1,659,917	3.3
Tocantins	569,896	1.1
Maranhão	999,830	2.0
Total Legal Amazon	50,145,998	100.0
Total Brazil	65,850,417	
% Amazon / Brazil	76.2%	

Source: IBGE, 1991.

Another indication of the predominantly small-scale production can be found in the average production of sawmills. We will come to this in

1. For some states the UFRRJ inventory presents a stratification of the sawmills' production capacity. In some of these stratifications, this capacity is expressed in m^3/month and in other cases in m^3/year. In the latter case, it is not specified as to whether the seasonality of the production has been taken into account. Moreover, the division into production classes is not consistent. For other states no stratification is given at all. Finally, much information is lacking, even when a stratification is presented. Data on the production capacity of sawmills in Pará, for example, are only available for 71.4% of the registered firms. Taking this into account, we consider these data too unreliable to be used here.

Section 3.2, where we compare the averages found in other studies with those of the sawmills in our survey.

The overall production capacity of the Amazonian timber industry can be derived from Table 3.2, which shows the volume of roundwood production by state. As most sawmills process only raw materials from the state where they operate (UFRRJ, 1984) and almost no roundwood is transported to other states, it may be used as an indicator of the regional distribution of the sector's production capacity. As can be seen, the bulk of roundwood originates from the states of Pará, with a share in the total Amazonian roundwood production of 86%.

Rondônia's share in roundwood production (4.5%) is much lower than we might expect on the basis of its number of sawmills. This can only partially be explained by the relatively small area of the state. More important explanatory factors are the high selectivity of timber exploitation in this region and its close relationship with colonization. Exploitation focuses heavily on mahogany and cerejeira (*Torresea acreana*), with much waste of other timber species when clearings for agriculture are made.[2] Moreover, wood processing in colonization areas has a secondary character, as can be seen in Section 3.2.2., resulting in low production figures per sawmill. This is confirmed by Browder (1986), who indicates that the average output of the small semi-mobile sawmills at the pioneer fronts of Rondônia is lower than that of the average sawmill in the Legal Amazon.

One of the most striking features of the wood-processing industries and something which emerges from every inventory and study, is how recently most of them have been established. According to UFRRJ (1984) 67.1% of all wood-processing industries in the region (with the exception of Amazonas) were established after 1980.[3] In areas recently opened up such as Rondônia, 100% of all sawmills covered by the UFRRJ inventory were opened after 1980. This fact is associated with the rapidly changing character of the Amazonian timber industry. It is also explained by the instability and precarious economic situation of most sawmills, which generally work with obsolete and deficient equipment. As we have mentioned in Chapter 1, it is relatively easy to establish a new sawmill, but

2. Groeneveld (1987) estimates that in Rondônia only 3-6% of the standing timber is utilized when a forest is cleared for agriculture, while the remainder is burned.
3. Data on the state of Amazonas were not available during our stay in Brazil.

much more difficult to develop it into a stable enterprise. Almost every study on the Amazonian timber industry mentions the same problems:

- the seasonality of log supplies, with the shortage of raw material during the rainy season for regions dependent upon road transport and shortage in the dry season for sawmills dependent upon supplies by river;
- lack of capital for stocking raw material or for improving equipment and lack of possibilities for gaining finance;
- low level of technology, obsolete equipment and lack of spare parts;
- lack of a skilled and stable work-force; and
- deficient infrastructure such as power shortages and a lack of roads passable all the year round.

In the light of this general background and the global features of the Amazonian timber industry, we will now turn to the sawmills in our study area.

3.2 The timber industry in the Santarém region: general features

3.2.1 Location aspects

As we have already noted in Chapter 1, the majority of the sawmills in the Santarém region can be found along the major roads. This also holds true for most of the 26 firms which are located in the city. The larger sawmills in particular, prefer a location on the fringe of the city, close to one of the supply routes. Some sawmills were located on the city's periphery when they were established but are now surrounded by residential areas as the result of the city's expansion. Only a few minor sawmills, which inconvenience the neighbourhood very little, were settled in urban zones.

In 1989, twelve sawmills were found along the exit roads (the Santarém-Curua Una road and the road from Santarém to Cuiabá, up to the Transamazônica). In the municipalities of Rurópolis, Santarém and Uruará along the Transamazônica, the number of sawmills amounted to 25.

A timber company from Belém exploited the forest near Vila Boim, a small village along the Tapajós river. Data on this company are presented together with those of the other ten companies from Belém that were included in our survey.

The ten companies which we visited in Belém, were also located at the access route of the city (the BR-316 from Brasília), at the Rodovía Arthur

Bernardes along the margin of the Amazon river or in industrial parks in the satellite cities of Ananinduea and Icoaraçí.

The reasons for this location pattern, with settlement on the urban periphery or along the major roads are obvious:

- The most favourable conditions for the supply of raw material are to be found along roads which are passable during most of the year and which can bear the heavy load of timber trucks. In cases where logs are supplied by river, the most favourable location is on the river bank.
- A sawmill not only causes noise nuisance but also air pollution as a result of the burning of sawdust and residues. Entrepreneurs who opt for an urban location therefore prefer to settle outside of residential areas.
- The larger sawmills in particular need space for the buildings and the storage of logs and sawnwood.
- Sawmills outside the city principally come in the wake of clearings for farming and cattle-raising and the supply of roundwood that accompanies the expansion of agricultural activities. They generally belong to the colonists who settled along the roads.

Table 3.3 illustrates the motives of sawmill owners for selecting a particular production site. The table shows that all large companies in Belém opted for this city because of the availability of raw material. That does not mean that logs can be found in the neighbourhood, but they can easily be provided as there are good transport facilities in all directions - by river, as well as by road. Other location advantages of the city of Belém are its infrastructural facilities - the export harbour in particular - and the local demand for timber.

In the interior, the locational choice often has nothing to do with logging or wood processing. For most sawmill owners the production site is the land which they already possessed and cultivated. They settled there as farmers and decided afterwards to make use of the wood resources available and to open a sawmill. Land ownership previous to the establishment of the sawmill is mentioned explicitly as a location factor by 72.7% of the sawmill owners along the exit roads from Santarém and by 41.7% of the sawmill owners along the Transamazônica.

The availability of wood resources, which is mentioned by 27.3% and 37.5% of the sawmill owners along the two roads in the interior, is not as much a pull factor as it is for the large companies in Belém, but rather a

reason for not changing the location when it was decided to establish a sawmill.

There is much more diversity of motives for establishing a sawmill in Santarém. Nearly 40% of the sawmill owners had no particular motive for their locational choice but settled at a place where they could take over a sawmill from a previous owner. The same percentage opted for the city because of the availability of raw material. Others were attracted to Santarém because of its infrastructural facilities such as the harbour, the airport and the road to Cuiabá (34.8%). Other motives for chosing Santarém were the local demand (21.7%), the existing potential for expansion in comparison with southern Brazil (17.4%), and its central location in the Amazon region (13.0%).

Table 3.3 Location factors

Motive	Santarém (n=23)	Exit roads (n=11)	Trans-amazônica (n=24)	Belém (n=8)	Total (n=66)
Raw material	39.1%	27.3%	37.5%	100.0%	43.9%
Expansion possibilities	17.4%	-	4.2%	-	7.6%
Take-over possibility	39.1%	9.0%	12.5%	-	19.7%
Already owned the land	4.3%	72.7%	41.7%	-	28.8%
Infrastructural facilities	34.8%	18.2%	4.2%	37.5%	21.2%
Availability of labour	8.7%	-	-	25.0%	6.1%
Central location	13.0%	-	-	-	4.6%
Market	21.7%	-	16.7%	25.0%	16.7%
Other motives	17.4%	18.2%	16.7%	12.5%	16.7%

Source: Author's fieldwork, 1989.

Most (59) sawmills consist of one single establishment. Six companies have one or two branches at another location in the Amazon region and seven sawmills are subsidiaries of a firm with its headquarters outside the region: three in the Amazon itself and four in southern Brazil.

One of the most salient features of the Amazonian timber industry is, as we had already noted in the previous section, the recent date of establishment of most sawmills. This also holds true for the wood-processing industries in the Santarém region. More than half of the surveyed sawmills (54.9%) were established less than five years ago. Each

year new sawmills spring up and others close down or change ownership. It is also not unusual to start with a clean slate when problems arise with respect to labour regulations, the taxation office or creditors. In those instances the old sawmill or company is 'closed' only to restart under another name. A few sawmills previously formed part of a larger company owned by more people. They continued as an independent establishment when the company was split up.

In Table 3.4 the age of the sawmills in our survey is compared with the results of the studies of Bruce (1976) and Mercado (1980). We found an age distribution which comes close to the findings of Bruce. The sawmills included in Mercado's study, appear to be even younger. Only 6.2% of them were established more than eight years before the year of reference (1978); a low percentage as compared with the 22.8% in our survey and 26.1% in the study of Bruce. In Mercado's study, 72.3% of the sawmills are no older than four years. This percentage amounts to 44.3% in our study and 47.4% in Bruce's analysis.

Table 3.4 Age of sawmills

	Bruce (1974)		Mercado (1978)		Ros-Tonen (1989)	
Age	Abs.	%	Abs.	%	Abs.	%
0-2 years	86	30.0	207	36.8	13	18.6
2-4 years	50	17.4	200	35.5	18	25.7
4-6 years	59	20.6	90	16.0	11	15.7
6-8 years	17	5.9	31	5.5	12	17.2
> 8 years	75	26.1	35	6.2	16	22.8
Total	287	100.0	563	100.0	70	100.0

Sources: Bruce (1976), Mercado (1980) and Author's fieldwork, 1989.

Another feature of the timber industry in our study area and which also emerges from other studies, is its high mobility. Twelve sawmills (16,9%)

were originally established in southern or southeastern Brazil (Table 3.5). Two sawmills (2.8%) were brought in from abroad (Japan and France).[4] Five sawmills (7%) were initially established in another part of the Amazon region; a percentage which is slightly lower than the 11.8% mentioned by Bruce. The equipment, however, is more mobile than the owners. No fewer than 71% of the sawmill-owners along the Transamazônica had bought their machinery from someone who had worked with it at another location along the road.

Table 3.5 Migration of sawmills and sawmill owners

Region of origin	Incl. sawmill	Excl. sawmill	Total	%
Amazon	5	8	13	18.3
Northeast	-	11	11	15.5
Southeast	2	1	3	4.2
South	10	30	40	56.4
Various	-	2	2	2.8
Abroad	2	-	2	2.8
Total	19	52	71	100.0

Source: Author's fieldwork.

As can also be derived from Table 3.5, only 13 sawmills (18.3%) originated in the Amazon region itself. All other sawmills were owned by entrepreneurs from other parts from Brazil; most of them from the South (56.4%) and to a lesser extent from the Northeast (15.5%).

Approximately a quarter of the owners who migrated to the Amazon already operated their sawmill in the region from where they originated. They displaced the sawmill as raw material became increasingly scarce. As logs had to be transported over ever-increasing distances, it was more

4. The presence of foreign capital in the Amazonian timber industry is not very pronounced. Most sawmills are Brazilian. There are, however, some very large multinationals operating in the region such as Eidai (Belém) and Toyomenka (Macapá) from Japan, Georgia Pacific (Portel and Breves), Lawton Lumber Co. Inc. (Belém) and Atlantic Veneer (Cuiabá) from the United States and Amazonas Timber (Manáus) from Germany (Garrida Filha, cited by IBASE, 1985). One company which formerly belonged to a Dutch enterprise (Bruynzeel) has been bought up by a Brazilian group.

economical to settle in the Amazon. A second reason for displacing the sawmill to the Amazon was the lack of expansion possibilities in the South, whereas the Amazon offered more space and cheap land. Six out of the 14 sawmills from other regions still have their headquarters or a subsidiary in the region of origin.

The owners from the Northeast migrated without previously having owned a sawmill. Their sawmills are generally small and product of many years saving after years of hard work as a wage-earner or in self-employment.

Table 3.6 shows the motives of the sawmill owners for migrating to the Amazon. Many of them - particularly those who settled along the Transamazônica and the exit roads from Santarém - principally migrated to the Amazon region because farm land was available at low cost and because they thought that their living conditions would improve. The people giving these motives were generally landless or peasants from northeastern and southern Brazil who had lost any hope of a future in the region where they lived. They had not intended to establish a sawmill when they had decided to settle in Amazonia. This is also illustrated by the little import given to motives related to timber exploitation (availability of raw material, lower transportation costs and expansion possibilities).

Table 3.6 Motives for migration to the Amazon region

Motive	Santarém (n=16)	Exit roads (n=8)	Trans-amazônica (n=23)	Belém (n=8)	Total (n=55)
Abundance of raw material	18.8%	12.5%	4.3%	87.5%	21.8%
Lower transportation costs	6.3%	-	4.3%	12.5%	5.5%
Availability of land	6.3%	62.5%	73.9%	-	41.8%
Expansion possibilities	12.5%	12.5%	-	-	5.5%
Tax incentives	-	-	-	25.0%	3.6%
Government propaganda	6.3%	-	4.3%	12.5%	5.5%
Improvement of living conditions	31.3%	50.0%	30.4%	-	29.1%
Other motives	31.3%	12.5%	4.3%	12.5%	15.5%

Source: Author's fieldwork, 1989.

On the other hand, owners of large companies in Belém primarily migrated to the Amazon region with timber exploitation in mind. The principal motive for investing in Amazonia, given by 87.5% of them, was the abundance of raw material which had become increasingly scarce in southern Brazil from where most of them had come.

The tax incentives for investing in the Amazon region were not a decisive motive for migration. Only two sawmill-owners, both with a large company in Belém, spontaneously mentioned them. When explicitly asked, nine more respondents admitted that they had played a role. Three of them obtained the incentives primarily for agricultural activities. The others were owners of fairly large companies.

3.2.2 Productive aspects

The principal product for more than half (56.3%) of the sawmills in our survey is plain sawnwood; board products which, in Portuguese, are referred to as *pranchas* and *tábuas* (Table 3.7). The sawmills outside the cities which are generally small and poorly equipped, are virtually exclusively engaged in basic primary processing of roundwood.

Table 3.7 Main products of the wood-processing industries according to their location

Product	Santarém (n=25)	Exit roads (n=11)	Trans-amazônica (n=24)	Belém (n=11)	Total (n=71)
Sawnwood	32.0%	81.8%	91.7%	9.1%	56.3%
Semi-processed timber	60.0%	18.2%	8.3%	27.3%	31.0%
Veneer and plywood	4.0%	-	-	54.5%	9.9%
Special wood products[1]	4.0%	-	-	9.1%	2.8%
	100.0%	100.0%	100.0%	100.0%	100.0%

1. Coachwork and pre-fabricated houses.
Source: Author's fieldwork, 1989.

The second most important end product is semi-processed timber; wood sawn and processed in such a way that it is ready for use as construction timber, such as rafters, construction girders, floor and ceiling boards and wainscotting. These products are the principal output of 60% of the

sawmills in Santarém city, indicating that their production is mainly oriented towards the local construction market. A few sawmills make special wood products, such as coachwork for trucks and pre-fabricated houses.

Sawmills which are engaged in the production of processed timber frequently sell part of their output in the form of plain sawnwood. These mills are not included in the percentage of 56.3%, as it is not their principal product. Veneer and plywood mills do not sell (processed) sawnwood as these products are not made by sawing, but through the peeling of the logs.

It can be seen from the table that there are hardly any sawmills in the Santarém region with a sufficiently high technological level to produce more than plain sawnwood or semi-processed timber. On the other hand, more than half of the large companies from Belém (54.5%) produce veneer or plywood as their primary output.

Table 3.8 Annual production according to location (1988/1989)

Location	No. of sawmills	Average production (m^3)	Total production (m^3)
Santarém	24	1,476	35,418
Exit roads from Santarém	11	410	4,512
Transamazônica	24	422	10,134
Belém	11	19,287	212,160
Total	70	3,746	262,224

Source: Author's fieldwork, 1989.

In the Santarém region production figures are low. In the colonization areas especially, the majority of the sawmills produce less than 500 m^3 (Table 3.8).[5] In total, 41 sawmills (58.6% of all enterprises in our survey and

5. To facilitate the comparison of output volume of enterprises with different kind of products, we converted all production into sawnwood equivalents. This is the actual annual production expressed in m^3 for sawmills which mainly produce plain sawnwood. In the case of semi-processed timber, we departed from the volume of sawnwood that was produced before further processing. In the case of products which are usually expressed in units other than cubic meters and in the case of products which per m^3 require other quantities of roundwood than is needed for the production of sawnwood, we started from the volume of logs which were used. We converted the volume of

69.5% of the sawmills in the Santarém region) produce less than 500 m^3 per year. Another 13 sawmills (18.6% of the total number of surveyed sawmills and 22.0% of the production units in the Santarém region) produce between 500 and 2,499 m^3 per year; a volume which is still considered to be small in other studies. Four enterprises (5.7% of the total surveyed and 6.8% of the sawmills in our study area) belong to the large sawmills which produce between 2,499 and 4,999 m^3 per year. Only one enterprise in the Santarém region can be considered to be a large company in the category with an annual production higher than 5,000 m^3. This company alone has produced nearly as much as the 35 sawmills in the interior of the region taken together.[6]

The companies in Belém, which were selected on the basis of their size belong to the categories of large and very large enterprises. Three of them produced between 2,499 and 4,999 m^3 per year, whereas eight enterprises had an annual output of more than 5,000 m^3. Only the latter category is obliged by law to undertake sustainable forest management on the basis of their roundwood utilization of more than 10,000 m^3 per year.[7] The average annual production of the surveyed large companies in Belém amounts to 19,287 m^3; considerably higher than the mean annual production of 1,476 m^3 of the sawmills in the city of Santarém.

The average production of the surveyed sawmills amounted to 3,746 m^3 in 1988/89. This figure is slightly above the average of 3,288 m^3 of 1,640 sawmills registered at the IBDF in 1980 (IBDF, 1982). The average production in the studies of Bruce (1974), Mercado (1980) and Browder (1986) are somewhat higher, amounting to 4,782 m^3, 5,071 m^3 and 4,498 m^3, respectively.

Several factors contributed to the moderate productive performance of the sawmills in our study area. One of the main factors is that most sawmills realize their annual output during a period of five or six months. Most of them suffer from a lack of sufficient working capital to build up a stock of raw material for the rainy season. When no more logs are

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utilized logs into sawnwood equivalents on the basis of an average recovery rate of 50% for sawnwood.

6. See Appendix 2 for a complete overview of total and average annual production according to location and output class.

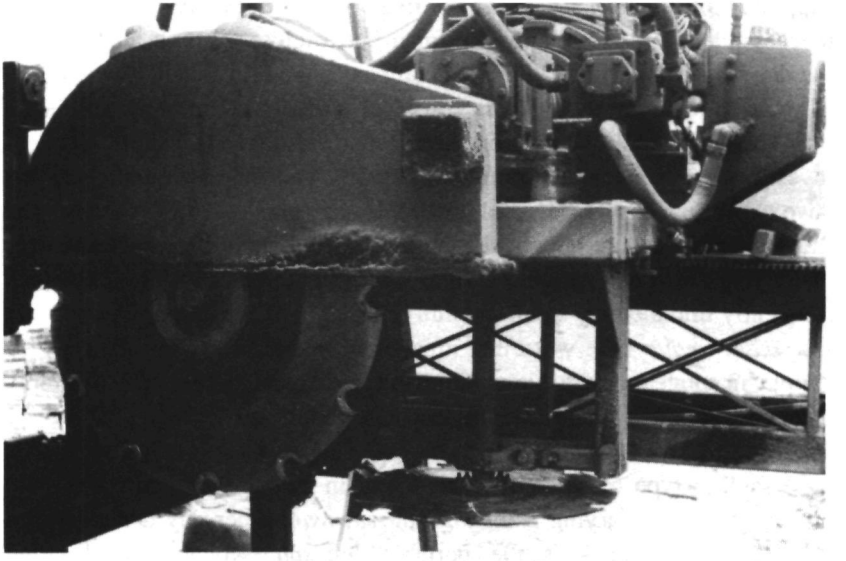
7. The latest regulation prescribes a management plan when more than 12,000 m^3 of roundwood is consumed per year (Chapter 5).

supplied because the heavy rains make roads impassable and forests inaccessible, there is nothing else for it but to close the mill and wait for the dry season to arrive. Only large companies have sufficient raw material in stock to maintain their production level throughout the rainy season.

The lack of financial resources also results in a low level of investment. Machines are primitive, obsolete and of poor quality. As we have mentioned before, up to 71% of the sawmills along the Transamazônica were bought second-hand after having been in service for many years for one or more previous owners at another location. One can frequently find the very small sawmill referred to as *pica-pau* - woodpecker - or *xeque-xeque* - the word that imitates its sound of sawing. It is a very simple machine, with a slowly moving horizontal blade, which simply resembles a large handsaw. Its capacity does not exceed 1-2 m^3 of sawnwood a day.

Another type of sawmill to be found in the interior, with a slightly higher capacity - varying from 6-20 m^3 sawnwood per day depending on the type of motor - is the portable *Induspa*, which saws the log simultaneously crosswise and along the bottom with two circular saws.

The most simple sawmill (pica-pau or xeque-xeque).



A portable sawmill (Induspa).

A third type of sawmill, the most common one in the city of Santarém, is the band saw. It has a long flexible blade which is placed round a vertical wheel with a diameter of approximately one and a half metres so that the machine saws in a continuous motion. The capacity of band saws varies from 18-22 m^3 per day, depending on the diameter of the wheel.

A common feature of all types is that spare parts must be supplied from regions outside Amazonia. This usually means a long waiting time, especially outside the cities, when the machine is broken and new parts are needed. The poor electricity supply also causes the sawmills to stand idle now and then.

A factor which is important for sawmills in rural areas in particular, is that wood processing is more often than not combined with other activities. As Table 3.9 shows, 80% of the sawmills in the colonization areas are combined with agriculture, with the latter as the initial and generally the prime activity. As a consequence, not all of the owner's time can be spent in the sawmill. Moreover, labour input is minimal. Whereas all companies

The band saw.

which were visited in Belém employ at least 50 people and 60% of the Santarém sawmills have more than 10 employees, the majority of the sawmills along the Transamazônica work with, at most, five men, often members of the family. No labour division exists between loggers and sawyers. If raw material is needed, production is halted while the wood is extracted from the forest. This means that, on average, one third of the working time is spent in supplying the sawmill with logs.[8]

8. Some owners of the enterprises in the cities of Belém and Santarém - 36.4% and 28.0% respectively - are also engaged in agricultural activities. The difference between them and their colleagues from rural areas is that, for most of them, agriculture is not their prime activity but more the result of a reinvestment of profits from the timber

Table 3.9 Additional activities

Principal additional activity	Santarém (n=25)	Exit roads (n=11)	Trans-amazônica (n=24)	Belém (n=11)	Total (n=71)
% of enterprises with additional activities	56.0%	81.8%	79.2%	63.6%	69.0%
Agriculture and/or cattle-raising	28.0%	81.8%	79.2%	36.4%	54.9%
Transport	12.0%	-	-	36.4%	9.9%
Other industrial activities	8.0%	-	-	9.1%	4.2%
Other activities	24.0%	-	12.5%	27.3%	16.9%

Source: Author's fieldwork, 1989.

3.3 Summary

In this chapter we have presented an overview of the general features of the Amazonian timber industry and a first characterization of the timber industry in our study area. We have distinguished three periods in the development of the Amazonian timber industry. The latest phase, from the 1960s onwards, has shown a rapid increase in wood-processing activities along the new roads in colonization areas.

We have seen that the main location factors at macro-regional level are the availability of and physical and juridical accessibility to forest resources, the connection with the markets for hardwood, the supply of labour and the availability of public and other services.

Amazonian sawmills are characterized by their low and elementary production, their short period of operation and the economic vulnerability of the small sawmills, in particular. The main production problems region-wide are seen in the seasonality of log supplies, the lack of capital, the low level of technology, the lack of skilled labour and a deficient infrastructure.

Most of these general features of Amazonian sawmills also characterize the timber industry in our study area. With respect to location factors, we have seen that, at micro-level, sawmills tend to locate on the cities' periphery and along the major roads in rural areas. These locations

industry, generally in cattle ranches.

guarantee the easiest supply of logs, offer space and do not compete with the residential function of more central parts of the city. We also highlighted the location motives for the particular production sites. In the cities Belém and Santarém, the main factors were the availability of roundwood, the infrastructure, local demand and the possibility of taking over an existing production site. In the interior, the production site is generally land which the owner already possessed and cultivated.

In our study area, too, most sawmills had been established recently, the majority not more than five years ago. Their owners generally come from other parts of Brazil, particularly from the South and Northeast. The participation of foreign capital in the region's timber industry is low.

With respect to the motives for migration to the Amazon region, a distinction must be made between sawmill owners who migrated as farmers and those who had timber exploitation in mind. The former migrated because cheap farm land was available and because they hoped that living conditions would be better in the Amazon. Later they decided to utilize the wood resources and to establish a sawmill as a secondary investment. For entrepreneurs who migrated to exploit the Amazonian timber resources, both push and pull factors played a role: scarcity of raw material in the South, increasing transportation costs and lack of expansion possibilities on the one hand, and the abundance of raw material and - to a lesser extent - tax incentives, on the other.

The production of the sawmills in the Santarém region is characterized by an even lower degree of processing and level of output than is average in Amazonia. Production is hindered by low investment, poor equipment, lack of roundwood stocking, lack of spare parts, a poor electricity supply and being combined with agricultural activities which absorb part of the time of the sawmill-owner. Sawmills in the interior also stand idle when logs are needed. How the timber industry is provided with roundwood will be dealt with in more detail in the next chapter.

4 Sources of raw material

In this chapter we will look at the timber industry as a consumer of raw material. After presenting an overview of the sawmills' raw material needs and the sources of roundwood, we will examine how the logs are supplied. To this end, we will make use of a scheme provided by Diane Rocheleau (1987) which we consider a useful tool for the analysis of roundwood supplies. Rocheleau takes the forest users and their relation to forests and trees as a starting point for (agro)forestry research. She distinguishes forest users by activity (producers, market vendors, consumers), by management unit (individual, household, companies or cooperatives and government administration units) and by right of access to and ownership of trees and/or land (owner, tenant, user by permission and squatters or illegal users). In our case the activity at issue is commercial logging. We will describe the extraction process in different circumstances (*várzea* and *terra firme*) and at various technological levels. We then look at the management units or actors involved, paying special attention to the relationship between the autonomous lumberman or *madeireiro* and the sawmill. In the last section of this chapter, we will examine how land and tree tenure are arranged in our study area.

4.1 Use and origin of roundwood

Timber exploitation in the Amazon has been highly selective for a long time. The number of tree species in the Amazon forest is estimated at 2,500 to 3,000 (Doureojeanni, 1981). The number of tree species which are actually used by the timber industry is notably lower. When Bruce (1976) made his inventory of roundwood utilization in 1972, the Amazonian sawmills processed only 166 species. Production was particularly focused on virola (*Virola* spp.) and mahogany (*Swietenia macrophylla*), respectively accounting for 38% and 22% of all roundwood consumption. Moreover, 90% of total roundwood consumption was based on no more than 23 species. By 1978, the total number of utilized species amounted to 228 (Pandolfo, 1978). On average, less than 10% of the standing timber is used.

As the result of improved information about the properties, workability and possible end uses of Amazonian timber species provided by the work of the IBDF, the INPA in Manáus, the IPT in São Paulo and the CTM in

Santarém, we would expect an increase in the number of species currently accepted on the market. Consumers in the region itself fulfil a kind of 'pioneer function' in this. The shorter the distance to the forest resource, the less selective are the consumers. By using species which are largely unknown outside the region, local consumers provide the opportunity to test the timber's qualities and availability (Bruce, 1976; Browder, 1986; IBDF, 1986).

More recent studies indicate, however, that exploitation continues to be highly selective. On the basis of a survey among 323 wood-processing industries all over the Amazon region, the IBDF (1986) concluded that, in 1983 only 250 species were used, only a slight increase in comparison with 1978. Production was particularly focused on 14 species which, together, constituted 75% of total roundwood inputs.

A case study involving three logging areas in the municipality of Paragominas indicated that no more than 83 tree species were extracted (Veríssimo et al., forthcoming). A similar study, also undertaken in eastern Pará in the municipality of Tailândia, points to even more selectivity, with no more than 15 species being harvested on three logging sites (Uhl et al., 1991).

Ten years after Bruce's inventory, the 'filet mignon' among the timber species are still mahogany (*Swietenia macrophylla*), virola (*Virola* spp.), Barbados cherry/cerejeira (*Torressea acreana*), and breu sucuruba (*Trattinickia* spp.) which together account for 39.5% of total log consumption (IBDF, 1986). Insofar anything has changed with regard to the selectivity of exploitation, it is in the less pronounced dominance of virola and mahogany, which has dropped from 60% of total roundwood utilization in 1973 to 24.4% in 1983.

Which species are used, depends on the destination of the sawmill's production and the location of the forests from where the raw material originates. The principal and most valuable species already mentioned above are mainly exploited for export. Other hardwood species of good quality have wide acceptance on the national market but are still unknown on foreign markets. Examples of this group are the angelins (*Hymenolobium* spp., *Pithecellobium* spp. and *Dinizia excelsa*), cedro-rana (*Cedrelinga catenaeformis*) and tigerwood/muiracatiara (*Astronium lecointei*), the latter being widely used in the Brazilian furniture and veneer industry (Bartels, 1980). Local consumers - whether or not forced by their low incomes - are less selective and accept timber denoted as *madeiras brancas*, which is

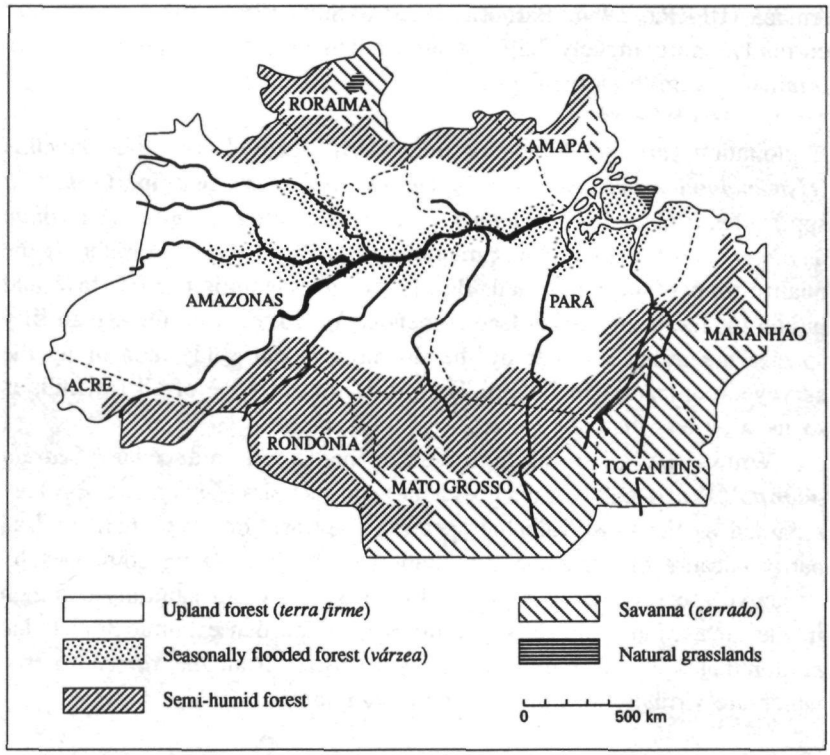
generally regarded as qualitatively inferior. Such species are fava (*Parkia multijuga*), butternuttree/piquiá (*Caryocar villosum*) and cupiuba (*Goupia glabra*).

With regard to the location of the roundwood source the most essential distinction is between the seasonally inundated lowland forests (*várzea*) and the non-flooded forests located in more elevated parts (*terra firme*). Both forest types differ in composition and density. Typical *várzea* timbers are, in addition to virola, seringueira (*Hevea guianensis*), sumauma, cotton tree (*Ceiba pentranda*), possum wood/assacu (*Hura crepitans*) and muiratinga (*Olmedioperebea sclerophylla*). All these species are characterized by light colour, low weight and relatively easy workability and are principally used for veneer and plywood production. A timber species from the *várzea* forest, which is commonly used as construction timber is andiroba (*Carapa guianensis*) (Bartels, 1980; IPT, 1985; IBDF, 1986). The total wood volume in *várzea* forests is estimated at 90 m^3/ha, of which 30 m^3/ha of tree species with commercial value (Pandolfo, 1978).

Upland forests (*terra firme*) are denser with an average wood volume of 178 m^3/ha, of which 60 m^3 is considered to be marketable (Pandolfo, 1978). The most frequently used species from the humid forests are the angelins, the sucupiras (*Bowdichia* spp. and *Diplotropis* spp.), Brazil teak/ freijó (*Cordia goeldiana*), greenheart/ipê (*Tabebuia serratifolia*), andiroba (*Carapa guianensis*) and red cedar/cedro (*Cedrela odorata*), whereas mahogany, Barbados cherry/cerejeira and locust/jatobá (*Hymenaea* spp.) are found in the semi-humid parts (IPT, 1985) (Map 4.1).

The distinction between *várzea* and *terra firme* forests is also important because these areas differ in accessibility and ownership. The *várzea* forests are virtually exclusively accessible by river and are generally public property. Forests on the *terra firme*, on the other hand, are reached by road and - as far as the accessible tracts are concerned - are largely in hands of private owners or land squatters. This aspect explains why logging in both contexts is organized in a differently. We will return to this in the next sections where we will describe different logging methods and land and tree tenure.

With 6.5 million ha, the *várzea* forests comprise less than 5% of the Amazonian forest but exploitation has long been confined to these areas.



Map 4.1 Forest and vegetation types in the Brazilian Amazon (based on SUDAM, 1986).

Several official documents published by both Brazilian and international agencies, point out that, even until the early 1970s, as much as 80-90% of the raw material used by the Amazonian timber industry originated from the *várzea* (Knowles, 1971; Pandolfo, 1974; Bruce, 1976; Valverde, 1980 citing Schmithüsen, 1978). This picture began to change after the construction of roads to open up the region. The amount of timber from *várzea* forests had already dropped to 60% by the end of the 1970s (Rankin, 1985 citing Carvalho, 1981). By 1984, all logs in Rondônia, Acre, and Roraima and at least 88% of all roundwood in the state of Pará and 95% of the raw material processed in Mato Grosso, were supplied from the *terra firme*, whereas exploitation of *várzea* forests maintained its importance only in the traditional and now minor logging areas of the states of Amazonas and

Amapá (UFRRJ, 1984; Barbosa, 1985; Santos, 1988). We estimate that currently approximately 85% of all roundwood in the Amazon region originates from the *terra firme*.

Exploitation in the Santarém region is focused on the angelins (*Hymenolobium petraeum* and *Dinizia excelsa*), greenheart/ipê (*Tabebuia* spp.), locust/jatobá (*Hymenaea courbaril*), muiracatiara (*Astronium lecointei*) and bulletwood/maçaranduba (*Manilkara huberi*), as far as the quality timbers are concerned. Besides, many sawmills process fava and piquiá for the local market (see Appendix 3).[1] In total, no more than fifty species are utilized, either by the sawmills in our study area or by the surveyed companies in Belém. The production of 69% of all sawmills is focused on less than ten species.

Within the group of high quality hardwood, red cedar (*Cedrela odorata*), Brazil teak (Cordia goeldiana) and sucupira (*Diplotropis* spp.) are regarded as the most valuable species. They are, however, hard to find partly because of excessive exploitation in the past. Other commercially attractive species such as virola and mahogany are not naturally common in the area. Mahogany does not flourish in the dense humid forest that predominates in the region. Virola is a species from the *várzea* forests, which are virtually unexploited in our study area.

Data obtained from interviews do not allow an accurate distinction to be made between the amount of roundwood originating from the *várzea* and from the *terra firme*. In some instances of river-based extraction not *várzea* but the *terra firme* was exploited. It was possible, however, to trace the approximate location of logging sites and to determine whether wood extraction took place in virgin forests or in tracts of forests to be cleared for agriculture. In general, the exploitation of virgin forest took place in the *várzea*, whereas the clearings were located in the upland forests.

Timber extraction in the Santarém region appeared to be closely associated with the conversion of forest into farming land and pasture. Total

1. This list must not be seen as being an exhaustive inventory of the number and relative importance of species which are used in the Santarém region as it was not the intention of our study to discover in detail, how many and how much of each species was used by the timber industry. It is meant as an indication of the principal species which are in demand.

log consumption by the sawmills in our study area amounted to 111,293 m^3 in 1989, of which 79,313 m^3 (71.3%) came from clearings. The remaining 28.7% (31,980 m^3) originated from virgin forests, independent of forest clearings for agriculture (Table 4.1). More than half of this amount (16,800 m^3) originated from the *terra firme*, whereas the remaining 15,180 m^3 - 13.6% of all utilized roundwood - probably originated from *várzea* forests.

The sawmills along the exit roads and the Transamazônica obtained all their roundwood from clearing upland forests and in Santarém city this percentage amounted to 59.9%.

The large companies from Belém obtained a larger part of their raw material from virgin forests which are mainly *várzea* forests located in the region of the islands to the north of the city and near the mouth of the Tocantins river. But these companies too, which are not located in or near a colonization area, obtained 49% of their roundwood input from clearings.[2]

Table 4.1 Log consumption in 1989 according to its origin (x 1,000 m^3)

	Location of sawmill									
	Santarém		Exit roads		Trans-amazônica		Belém		Total	
Origin of raw material	Abs.	%	Abs.	%	Abs.	%	Abs.	%	Abs.	%
Clearings-own exploitation	14	*17*	6	*55*	10	*48*	34	*8*	65	*12*
Clearings-lumbermen	34	*43*	5	*45*	11	*52*	169	*41*	218	*42*
Subtotal	48	*60*	11	*100*	21	*100*	203	*49*	283	*54*
Virgin forest-own exploitation[1]	32	*40*	--	--	--	--	11	*3*	43	*8*
Virgin forest-lumbermen	--	--	--	--	--	--	200	*48*	200	*38*
Subtotal	32	*40*	--	--	--	--	211	*51*	243	*46*
Total log consumption	80	*100*	11	*100*	21	*100*	414	*100*	526	*100*

1. Includes management projects for the sustainable production of timber.
Source: Author's field research, 1989.

The volume of utilized roundwood in our study area - also presented in Table 4.1 - indicates that the scale on which the timber industry operates

2. The relationship between timber exploitation and agricultural settlement will be examined in more detail in the section on land and tree tenure.

differs widely between the various locations. Roundwood consumption by the 35 sawmills along the three major roads amounting to 31,535 m^3 in 1989, is small when compared with log consumption by the 25 sawmills in Santarém city (79,758 m^3) and only 'peanuts' when compared with the volume of raw material utilized by the surveyed companies from Belém (414,222 m^3). Roundwood input of the eleven firms from Belém is nearly four times as high as that of all 60 sawmills in the Santarém region put together. As we have seen in the previous chapter, in colonization areas in particular, timber exploitation is often a secondary activity taking place on a minor scale. Large firms, on the other hand, are primarily engaged in timber production and consume considerably more roundwood accordingly.

Another aspect illustrated by Table 4.1 - the volume of logs provided by exploitation by the company itself or by independent lumbermen - will be dealt with in the section on the actors.

4.2 The activity: description of the logging process

Logging in the Amazon is undertaken on different scales and technological levels. The most traditional way which relies on rudimentary techniques and much human energy, can be found in the *várzea* forests and the more isolated parts of the upland forests. These traditional operations can be undertaken to satisfy local needs for construction timber but also as a commercial activity to provide sawmills with raw material. The logging operation which we observed in the upland forests along the Arapiuns river, near the village of Aruã, was an example of timber exploitation oriented towards the demand of the community. The timber was extracted to provide material for the building of houses, small bridges and boats.

The harvested tree species were itaúba (*Mezilaurus itauba*)[3] for boat and bridge building and quaruba (*Vochysia maxima*), cedro-rana (*Cedrelinga catenaeformis*) and cupiuba (*Goupia glabra*) for use as construction timber.

The logs were processed into planks and beams with a chain-saw at the logging site to facilitate loading and transportation. Transportation of

3. Itauba is known for its resistance to water, fungi and termites and is therefore, more than any other wood, preferred for naval construction and water works.

complete logs would only have been a waste of energy as the timber would be used locally and there was no sawmill in the region.[4]

The timber was loaded by manpower and tied with liana onto an old vehicle which was not specially designed for log transport or heavy loads. A logging road, previously constructed, used and subsequently abandoned by a large timber company from Santarém, was used to provide a way through the forest and back to the village.

Commercial traditional logging is still prevalent in the *várzea* forests and has been described in detail by da Silva (1987) who observed a logging team in the region of the islands at the mouth of the Amazon river. She distinguished three phases in the extraction process:

1. Felling the trees (*derrubada*), including tree identification, the actual felling, the separation of crown and branches, the cutting into logs and measurement of the logs.
2. Transportation of the logs (*colocação*). This stage of the process is the most arduous and labour intensive. One of the tasks involved in this phase is the preparation of the *estiva*, a series of thin rounded stems such as those of the cabbage palm (*açaí*), over which the logs are rolled by hand from the felling site to the nearest watercourse. To facilitate the gliding of the logs along the poles, the bark is stripped, the prop roots and aerial roots are removed and one end of the log is shaped like a funnel. Next, the logs are floated out of the woods through the small inland watercourses called *igarapé*. To this end, the dry beds of the *igarapés* have to be kept free of trunks, roots, lianas and mud (*fazer o rego*). When the water level rises in the rainy season or at high tide in the areas under maritime influence, the logs are tied together in small quantities to be floated to the mouth of the *igarapé*.
3. Building of raft (*preparação da jangada*) at the mouth of the inland watercourse, with use of steel pins and cables provided by the buyer of the logs. The pins have a loophole through which the cable runs.[5]

4. An indicator of the non-market oriented nature of the operation was the use of the traditional *palmo* (22 cm); a measure no longer in use among sawmills. For instance, the standard thickness for planks was 0.6 *palmo*, for cross-beams to be used in house construction 1 *palmo* and for beams for use in boat building 2 *palmos*.
5. Traditionally, lianas and aerial roots were used to form a raft.

At this point, the buyer takes over the transport to the sawmill as the lumbermen do not own a towboat (*rebocador*) to transport the raft.[6] The distances between the logging site and the sawmill in the case of water transport range from less than 200 km in the Belém and Marajó region to over 1,000 km in the state of Amazonas (Bruce, 1976; Almeida, 1985; Rankin, 1985; da Silva, 1987).

Equipment used in the operation described above is rudimentary consisting only of an axe (*machado*) and machete (*terçado*) in the islands region. In other areas where traditional logging of *várzea* forests prevails, the axe has now generally been replaced by the chain-saw (Almeida, 1985).[7] Before the introduction of the chain-saw, it was also common to use a two-handled cross-cut saw (*roladeira* or *serrotão*) to divide the trunk into logs.

As the transportation of logs out of the forest depends on high water levels, the peak of log deliveries from *várzea* forests is the rainy season. This peak is called the tree harvest (*safra da madeira*).

Timber extraction in the upland forests is more mechanized. In its most elementary form, equipment consists of a chain-saw to fell the trees, a machete and an axe to clear the logging roads and a specific logging truck which is specially designed for the transportation of logs. The truck is equipped with a winch to facilitate loading and has a loading capacity of

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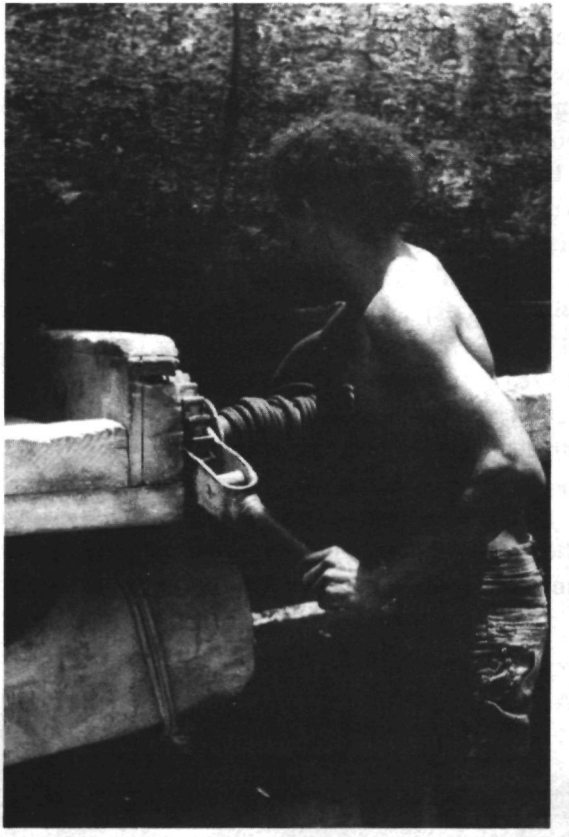
6. In areas where it is more common to transport the logs by barge (*balsa*) and tugboat, the lumbermen can pile up the logs at the river-side. To this end the buyer usually provides a front-end loader. In these cases, however, it is probably not the *várzea* which is exploited, but a part of the upland forests which is not accessible by road. It is almost impossible to transport logs from upland forests in the form of rafts as only 10-20% of the timber species from these forests float (SUDAM, 1978).

7. Da Silva (1987) points to the fact that it makes no sense for the loggers in the *várzea* to substitute the axe for a chain-saw. In contrast with the chain-saw, the axe is multi-functional. It is, for instance, also used as a hand-grip for the lumbermen when the logs are floated of the forest and as a hammer to fasten the pins through which the steel cables run. Moreover, it is useless to increase the productivity of felling if the productivity in log transportation cannot also be raised. This is also illustrated by Almeida, who noted that the overall introduction of the chain-saw in the state of Amazonas during the 1980s did not result in higher productivity because of limitations to increasing productivity in other phases of the extraction process (Almeida, personal comment, 1988).



Logging truck equipped with a winch and steel cable.

five logs on average. In its semi-mechanized form, wood extraction in the upland forests consists of five phases:

1. Identification and marking of desired tree species with sufficient diameter (*explorar e deixar em pico*).
2. Felling of the tree, separation of the crown and branches and cutting of the trunk into logs of 4 meters average length (*derrubar e torar; aprontar a madeira*).
3. Clearing of small logging roads (*fazer ramal*) which link the extraction sites to the principal logging roads and permit access to the truck to pick up the logs. Those sites are linked only where the felled tree has proved to be an appropriate one to be delivered to the sawmill, e.g. not too

many fissures, termites, woodworm, rot, knots or other defects. Near the felled trees an open space is cleared with an area of approximately 150 m^2, where the truck can be loaded and turned (*limpar o virador*). In these operations only the machete and chain-saw are used.

4. Loading of the truck by attaching a steel cable from the winch to the log, thus levering it over two supporting poles (*levas*) or beams onto the truck (*puxar a carrada; embarcar na catraca*).
5. Transportation to the sawmill (*trazer a madeira*).

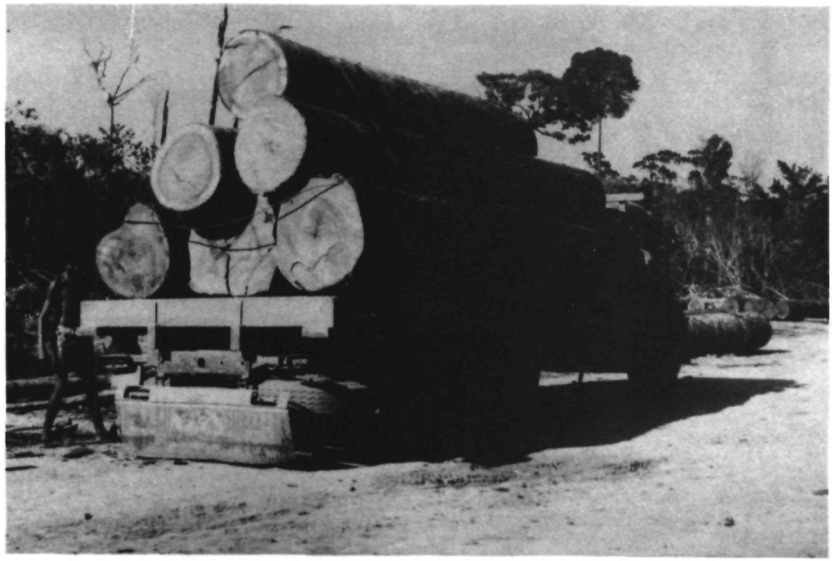
Sometimes timber is exploited in a tract of the forest which had already been burned in order to be converted into farm land. In these instances, timber is utilized which had remained upright or which was left on the ground and still can be used in small sawmills which produce for the local market. Although these areas have already been cleared of their undergrowth and burned, it is still necessary for the lumberman to clear a way across the field to pick up the timber. Many tree stumps which remained after the fire can hinder the access of trucks and have to be removed. Similar to road construction in a complete extraction process, this operation is called *fazer ramal.*

Loading of the truck.

Use of a tractor in timber extraction.

When a tractor is available, as is often the case when farmers are engaged in logging, it is used to construct the logging roads and to haul the logs out of the forest by fastening a steel cable to the head of the log. In this instance, the truck is not driven from felling site to felling site, but to a central open space or loading yard (*pátio*) where the logs are collected for loading.

Large scale operations which are only undertaken by the largest timber companies and are still not common in the Santarém region are mechanized even further. Logging roads and loading yards are constructed prior to the logging operation with the use of a bulldozer (*esteira*) and an equalizer (*niveladora*). The identification and felling of the trees take place as described above but a special forestry tractor (skidder) is used to drag the entire boles out of the woods to one of the loading yards where they are divided into logs. Front-end loaders (*carregadeiras*; *empilhadeiras*) are used to pile up the logs and to load the trucks. Instead of direct transportation to the sawmill, the logs are often transported to the nearest river-side, to be transported in larger quantities by barge and tugboat (*balsa e rebocador*).



Log transport by truck.

Log transport by barge.

Bulldozer.

Skidder.

4.3 The actors engaged in wood extraction

Sawmills and timber companies can be supplied with logs by several actors. Their relative importance for the sawmills in our survey is illustrated in Table 4.2. The basic distinction is between the logging teams or crews employed by sawmills who organize logging operations under their own control and third parties (*terceiros*) who work autonomously and sell roundwood to the wood-processing industries. The latter can either be the extractors or timber merchants not engaged in logging. Some large firms employ one or more people specifically as buyers of raw material to make contact and do business with them.

Timber merchants who are not themselves engaged in the extraction process were not active in our study area. They are a more common supplier of roundwood for the surveyed companies in Belém (36.4% of all cases).

Similarly, the buyer of logs employed by a timber company is not a common actor in the Santarém region. Only one large firm engaged someone to obtain raw material from third parties. It is more usual to find this actor among the large firms from Belém (36.4% of all cases).

Occasionally, a logging job is given out to contract loggers (*derrubada por empreitada*). This practice is most often found on large estates (*fazendas*). In our study area only one sawmill, operating on a *fazenda*, worked with contract loggers. The employment of contract loggers occurs more frequently on the large cattle ranches in the Paragominas region (Vieira, personal comment, 1988).

Particularly in the cities, more than half of the sawmills (64% of the sawmills in Santarém and 54.5% of the surveyed companies in Belém) depend on third parties for their roundwood supply (Table 4.3). Among the large companies in Belém it was a minority of even less than 20% who provided more than half their roundwood through their own exploitation. The most common supplier, both in our study area and elsewhere in the Amazon, is the lumberman. These loggers - referred to as *madeireiros*[8] or

8. The term *madeireiro* can either refer to (a) the owner of a sawmill or timber company and is generally used in this sense in southern Brazil or (b) to a timber merchant who buys and resells logs and timber but is not himself engaged in wood extraction or processing or (c) to the autonomous logger who sells roundwood to traders or sawmill owners. The last meaning is the one which is in local use in the Santarém region.

toreiros - earn their living by the extraction, transportation and/or the vending of logs.

Table 4.2 Significance of various actors in the roundwood supplies of the surveyed sawmills (%)

Actors[1]	Location and % of sawmills Santarém (n=25)	Exit roads (n=11)	Trans-amazônica (n=24)	Belém (n=11)	Total (n=71)
Lumberman/colonist	28.0%	18.2%	16.7%	27.3%	22.5%
Lumberman/trucker	56.0%	36.4%	33.3%	54.6%	45.1%
Lumberman in várzea	12.0%	-	-	27.3%	8.5%
Contract loggers	-	9.1%	-	-	1.4%
Timber merchant	-	-	-	36.4%	5.6%
Own representative/buyer	4.0%	-	-	36.4%	7.0%
Own logging team	36.0%	72.7%	79.2%	45.5%	57.8%

1. More than one item possible per sawmill.
Source: Author's field research, 1989.

Table 4.3 Contribution of own logging operations to total roundwood supplies

Share	Location and % of sawmills Santarém (n=25)	Exit roads (n=11)	Trans-amazônica (n=24)	Belém (n=11)	Total (n=71)
None	64.0%	27.3%	20.8%	54.5%	42.2%
1-24%	-	-	4.2%	9.1%	2.8%
25-49%	-	18.2%	8.3%	18.2%	8.5%
50-74%	8.0%	-	4.2%	-	4.2%
75-99%	8.0%	9.1%	8.3%	9.1%	8.5%
100%	20.0%	45.4%	54.2%	9.1%	33.8%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Author's field research, 1989.

Lumbermen can be divided into workers of the *terra firme* and workers of the *várzea*. The different contexts in which they work influence the way they get the logs out of the forest (by river or by road), the equipment they

use, the capital they need and the tenure arrangements under which they work with private landownership prevailing in the accessible parts of the upland forests and the public domain being common in the *várzea* forests. We will come to the latter aspect in Section 4.4.

The lumberman of the upland forests is owner of a logging truck and often a small landholder, either or not combining logging with farming. An estimated 60-70 lumbermen are active in our study area. The majority live in the city and approximately ten lumbermen can be found along the Santarém-Curua Una road and about five along the surveyed stretch of the Transamazônica (in the village of Uruará, in particular). They are engaged in both logging and transportation. Studies undertaken in other areas indicate that there are lumbermen who are exclusively engaged in logging and lumbermen who only transport and deliver the logs to the sawmill (Browder, 1986; Uhl et al., 1991). This situation is highly exceptional in our study area. Only one sawmill, located in Santarém, occasionally made a deal with a trucker to carry logs on his way back from the Transamazônica, to where he was carrying other goods. In such cases, however, the trucker is not regarded as a lumberman.

Lumbermen generally employ three men: a sawyer to operate the chain-saw and two labourers (*braçais*) to clear the logging roads and to load the truck.[9] Equipment is restricted to the logging truck, the chain-saw and the machete. On average, they deliver 20-60 m^3 roundwood per week during the dry season. The most common practice is to deliver the logs at the mill gate but some of the larger companies agree to delivery at the riverside (*na beira do rio*) where they pick them up by barge. Five companies did so with their own barge and four others hired one when they needed it. Two sawmills occasionally made a deal to pick up the logs at the road nearest to the logging site (*na beira da estrada*).

In the Santarém region, arrangements between the sawmill and the lumberman are based on verbal agreements. Only the larger sawmills producing for export markets or specific orders specify in advance which species, quantities, length or diameter of logs they require. Small sawmills oriented towards the local market accept any log they can get. 'Whatever I deliver, he buys' was commonly heard from the lumbermen.

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9. Depending on the task at issue, these labourers are also called *ramalistas* (the men who clear the logging road or *ramal*) or *catraqueiros* (the men who load the truck by winch or *na catraca*).

Involvement in agricultural activities differs among the lumbermen in our study area. There are lumbermen who acquired land with the specific purpose of logging it and selling it afterwards, only to repeat the cycle on a new tract of forest with no intention of engaging in farming. Others, often with a primary home in the city, bought land with the intention of logging it and bring it into cultivation afterwards. Most of these lumbermen have their primary source of income from logging but they intend to switch to agriculture as a prime activity in the future. Generally these lumbermen hire someone to take care of their plot. Those lumbermen who are either wholly not or only marginally engaged in farming are indicated as 'lumbermen/trucker' in Table 4.2.

Finally, there are lumbermen who are agricultural colonists combining logging and farming, the latter being the prime activity. Some of them are regular loggers, whereas others only extract timber when they need sawnwood for which they exchange the logs. The latter are not regarded as lumbermen but principally as tree owners.

In Santarém and Belém, approximately 56% of the surveyed sawmills obtained part or all of their raw material from lumbermen who found their primary source of income in logging and timber transport. The lumberman/ colonist was a source of roundwood supply for 28% of the sawmills in the two cities. In the colonization areas, too, the lumberman/trucker plays a more important role than the lumberman/colonist. The share of lumbermen in total roundwood supply, however, is less pronounced than in the cities, as more sawmills obtain roundwood from their own logging operations.

With respect to *várzea* lumbermen da Silva (1987) distinguishes between the *diarista* - lumbermen who are paid for their work by a sawmill, timber merchant or chief logger - and the *convidado* - lumbermen who log the forest on the basis of traditional labour relations based on mutual help and exchange of working days between relatives and neighbours.[10] To be *convidado* means literally to be invited to work and that is what actually happens. Someone takes the initiative to undertake the logging and invites a relative, a friend or *compadre* to join him. They share the profits when the logs are sold.

10. In the upland forests it is more common to pay wages to the helpers.

During the dry season when the water level is too low to reach the logging sites or to float the logs out of the forest, most of these lumbermen are engaged in subsistence farming.

Lumbermen in the *várzea* do often not deal directly with sawmill owners but rather sell the logs to timber merchants who have the capital to finance the operation and to transport the logs. In general, it can be said that the greater the distance between roundwood source and sawmill, the more intermediaries are involved.

The number of sawmills who are provided with all or part of their raw material through their own forest exploitations tends to increase as the distance to the forest resource becomes shorter (Table 4.3). In the colonization areas where the distance between sawmill and logging site is less than 10 km in 50% of the cases and does not exceed 25 km in 90% of the cases , more than 70% of the sawmills employ their own logging teams.[11] This percentage amounts to 36.0% and 45.5% of the sawmills in Santarém and Belém, respectively.

About 20% of all sawmills combine their own logging operations with roundwood supplies by others. Only one third of the sawmills exclusively obtained raw material from their own exploitations, this percentage being the lowest for the surveyed companies from Belém (9.1%) and the highest for the sawmills located along the Transamazônica (54.2%).

Sawmills engaged in logging can be divided into three groups according to the scale and technological level on which they operate. The principal factors in this are the available equipment and the degree of labour division.

The lowest scale of exploitation is operated by the small logging team consisting of two to four men working together in all phases of forest exploitation with barely any labour division between them. These teams prevail among the small sawmills in the colonization areas, especially along the Transamazônica (Table 4.4). Frequently, the sawmill owner participates in the extraction process and, when available, family labour is employed in preference to hired labour. These small-scale operations are only undertaken when the sawmill is out of raw material. When the team is in the forest the sawmill stands idle. On average, ten days per month are spent logging. As

11. Distance to the roundwood source ranges between 100 and 125 km for most sawmills located in Santarém and generally lies between 125 and 250 km for the companies from Belém.

the logging site is close to the sawmill the team does not need to spend the night in the forest. The available equipment is limited to a logging truck and a chain-saw. Hence, the extraction process is similar to the semi-mechanized logging operation, described in the previous section. Daily production does seldom exceed 5 m^3.

Table 4.4 Scale of logging according to the location of the sawmills

Scale	Location and % of sawmills: Santarém (n=8)	Exit roads (n=9)	Trans-amazônica (n=19)	Belém (n=5)	Total (n=41)
Small	25.0%	33.3%	57.9%	-	39.0%
Medium	37.5%	66.6%	31.6%	-	36.6%
Large	37.5%	-	10.5%	100.0%	24.4%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Author's field research, 1989.

On the medium level, in addition to the logging truck and chain-saw one other machine is used and most frequently this is a tractor, although in some cases a front-end loader or a small bulldozer is used. The logging team consists of four men, each of them with a specific task. One man drives the truck (*motorista*), another operates the tractor, front-end loader or bulldozer (*operador de trator, carregadeira, esteira*), a third - if not one of the first two - handles the chain-saw (*motoserrista*) and one or two others are helpers who attach the cable of the winch to the head of the log and load the truck. At this level it is more common for the logging teams to work full-time in the forest while others do the work in the sawmill. However, one third of the loggers in this group are also engaged in wood processing which means that they generally spend no more than ten to fifteen days in the forest. Productivity on this level ranges from 5-20 m^3 per logging day, with an average of 10 m^3. Sawmills operating on this level are to be found in Santarém city and in the colonization areas, particularly along the exit roads.

In large scale operations the whole range of forestry equipment is used, such as front-end loaders, bulldozers and skidders. Only the largest firms operate on this level, although not all of them do. These operations are

constant during the dry season. Contrary to the small logging team which stays together in all phases of the extraction process, a stringent division of labour exists among the workers which is determined to a large extent by the available machinery. The only forest worker employed independent of any instrument or machine is the explorer (*mateiro*) who identifies the trees to be felled and marks where they can be found by leaving simple indicators of small branches and twigs. For all other operations it can generally be said that, for each machine, one operator and one assistant are employed. The sawyer's assistant (*ajudante do motoserrista*), for instance, carries drinking water, petrol and lubricating oil for the chain-saw and prepares the sawyer's work by clearing the indicated tree of its undergrowth and lianas and removing a strip of bark at the height where the tree will be cut. The assistant of the skidder operator fastens the cable by which the boles are removed.

Besides the personnel in the forest, there is also a cook and his mate to prepare meals and run the camp. On average, 20-30 men are employed in the logging operation. A foreman (*capataz*) is commissioned with the co-ordination of the work. Productivity ranges from 45-200 m^3 per day, with an average of 100 m^3 per logging crew.

4.3.1 Traditional labour relations: the aviamento system

One of the specific features of the Amazonian timber industry is the important role of lumbermen and other intermediaries in the supply of roundwood. As we have seen above, less than half of the sawmills in our survey obtain more than 50% of their raw material through logging operations under their own control. Expressed in the amount of roundwood used by the sawmills in our survey, 80% is supplied by lumbermen, a percentage corresponding to that given by Bruce (1976). In the light of the large quantities and regular supplies of raw material they need it is remarkable that even the large companies in Belém obtain as much as 89% of their roundwood from third parties (cf. Tables 4.1 and 4.3).

The question raised here is why these indirect supplies continue to be so important. The answer can be found in the economic behaviour of sawmills on the one hand and in the permanence of traditional production relations in the Amazonian extractive economy on the other.

Turning to the first facet, for many sawmills buying from lumbermen is the cheapest way to obtain roundwood. The sawmill does not need to

invest in the purchase and maintenance of logging equipment. Nor does it need to spend money on wages for workers who, due to unfavourable weather conditions, impassable roads or the breakdown of equipment cannot always be productive. This motive is important for many owners of small and medium sawmills in Santarém and its direct environs in particular who possess no forest land of their own. Their limited financial resources do not allow for too many expenses. The following sample quotation was heard many times during several interviews with sawmill owners in Santarém:

> 'It is expensive to maintain my own logging crews and equipment. For us, it is better to buy from *terceiros*. I don't have enough capital to finance everything: equipment, personnel, land. Moreover, the lumberman takes the risk; an employee doesn't. If there's a problem with the truck and it's your own, you have to pay for the spare parts and also for the workers who, at that moment, cannot do their work. If the truck is the lumberman's he can ask me to pay for the repair, but then he pays me back later, in roundwood.'

Another motive for preferring to get logs through lumbermen is that the sawmill-owner does not need to bother himself with the organization of the extraction process:

> 'It's less a cause of concern. It's a lot of work to organize one's own exploitation.'

A third - though less important - motive for buying from autonomous extractors or intermediaries is that it enables sawmills with their own forest areas to preserve these as a timber stock for the future.

> 'It would be better to extract wood from my own forest. But I prefer to keep it as a reserve for the future.'

Not every sawmill-owner buying from lumbermen is happy with this situation. The smallest producers, in particular, believe that it would be more favourable to log an area themselves:

'If we had our own forest land and a truck, it would be cheaper to undertake the logging ourselves. With our own exploitation we would be better off. But we are not in a position to do this.'

'If I had my own area, I could go there and extract wood whenever I needed it.'

An important factor in explaining why it is specifically the small sawmill-owner in the city who feels the disadvantages of indirect supplies is that he does not have the capital to finance a lumberman. Through the financing of a lumberman's activities a sawmill-owner can be sure of delivery. A sawmill-owner who cannot bind a log supplier is much more dependent on the willingness of a lumberman to supply logs at a reasonable price. The next fragment of an interview with a lumberman illustrates how this works:

'Normally, I deliver logs to two sawmills. But last month I had to repair the differential gear of my truck. I went to X and he arranged some money. When you get money from a sawmill, you have to deliver more logs to compensate for the expense. If not, you 'll be in trouble.'

That brings us to the second explanation for the important role of the lumberman in roundwood supplies: the persistence of traditional production relations. Although lumbermen work independently in the sense that they are not on the pay-roll of a sawmill or timber company and they are free to sell to whoever wants to buy, they generally maintain a relationship with one, or at most, two sawmills, in order to benefit from the opportunity of having their activities financed.

This type of production relationship is comparable with the traditional *aviamento* system, common in the rubber economy. It is a kind of credit system with no money involved. It stems from colonial times when forest products were collected for European markets but when money was not widely accepted by the Amazonian people. During the rubber boom it became the typical relationship between the rubber tapper (*seringueiro)* and his 'boss' (*patrão*): the owner of rubber trees (*seringalista*) or rubber merchant. The *patrão* supplied merchandise, tools and, in some cases, a small amount of money to the collector of forest products in exchange for the physical product at the end of the expedition. By creating an eternal

debt the supplier of merchandise (*aviador*) assured himself of delivery by the extractor. During the rubber boom, it was difficult to escape from the interior and the debts. If the rubber tapper was not killed by armed private guards, official policemen would send him back if he succeeded in reaching the city (Santos, 1980).

According to Santos (1980), the *aviamento* system tends to be reactivated in any economic sector characterized by:

- a spatially extensive resource base of difficult access;
- rudimentary production techniques;
- barter with little or no money involved;
- the presence of local mercantile leadership or agents capable of exerting such;
- the connection of this mercantile leadership with a monetary market in full operation and which, from the outside, provides credit; and
- an active external demand for one or more products of this sector.

Timber exploitation in the more distant and isolated *várzea* forests, in particular, answer to most of these features. As we have seen, the extractors work in isolated areas with simple means of production. Whilst they work in the forest money is of no value. They depend on timber merchants who act as intermediaries between the lumbermen and the timber industry and who organize the transportation of logs to the sawmill. These merchants frequently receive money in advance to be able to deal with the loggers. It is under these circumstances that the financing of lumbermen resembles the traditional *aviamento* system most. The extractors, who generally stay in the forests for long periods - from a few weeks in the islands region to up to eight months in the state of Amazonas - must be provided with food and other basic necessities such as cassava (*farinha*), dried fish and meat, beans, salt, sugar, coffee and tobacco. Furthermore, they are provided with rings and steel cables to prepare the rafts for the buyer. The chief logger (*chefe da turma*) may also receive money in advance to contract his helpers - the *diaristas* - and for the members of his family who stay behind in the village during the logging operation. Total advancement in general does not exceed 30% to 45% of the total value of that which is expected to be delivered (Almeida, 1985; Almeida, personal comment, 1988; da Silva, 1987; da Silva, personal comment, 1988).

In our study area where the logging of upland forests prevails, it is unusual for the sawmills to advance money for the primary necessities or the payment of salaries. But in this region, too, which is more opened up

and integrated into a monetized economy, it is not unusual to revert to traditional customs and to finance the lumbermen in exchange for his product. The most common situation is to pay for truck repairs or spare parts which are the largest costs for the lumberman in the upland forest. Occasionally even a whole truck can be advanced to bind the lumberman to the sawmill.

Whereas, traditionally, the relationship was disadvantageous to the debtor (*aviador*), who, at the moment of settling accounts could be confronted with a debit balance, all the lumbermen interviewed considered the advancement of money in case of need as a helpful gesture on behalf of the sawmill owner. The following quotation, heard in several interviews with lumbermen, illustrates this:

> 'If we need to buy a part for the truck or a new tyre, he is ready to help us. Whatever I need, I can go there and he pays. I pay him back in logs.'

The sawmill owners, on the other hand, regard the advancement as a rational strategy to ensure the supply of roundwood:

> 'We finance their truck, for example. Then they have a debt and have to pay back in roundwood'.

In general, the debt is small enough to be settled when the next one or two truck-loads are delivered. Most advances are paid back within a week so that the balance is in the lumberman's favour when the accounts are settled. If not - as had been the case for three of the interviewed lumbermen who had had their truck financed by the sawmill - a deal is made where half the value of the delivered load is paid to cover the expenses and the other half is discounted from the debt. In these instances, what is left is just enough 'to eat and to drink', but the lumbermen consider it a good deal as 'afterwards, the truck will be our credit balance'. Under these circumstances, the traditional *aviamento* system seems to have advantages for both parties. It enables the lumberman to get credit when he needs it and to maintain his (relative) autonomy. The sawmill, on the other hand, does not need to invest in the production factors needed for logging (forest land, labour and equipment), whereas at the same time it can be assured of regular deliveries.

Reviewing both factors that influence the role of lumbermen in the timber economy, we can now explain why they are much less important to the sawmills along the Transamazônica. Seen from the perspective of economic motives, there are fewer reasons for buying logs from lumbermen in the colonization areas. Exploitation costs are lower for the sawmills in these areas because they operate closer to the source of roundwood and their owners were already in possession of forest land before they established the mill. When family labour is available, buying logs from lumbermen would be more expensive than obtaining roundwood from their own exploitations.

Seen from the conditions under which the traditional *aviamento* system tends to be reactivated can conclude that few of these conditions are fulfilled in the colonization areas. Roundwood is available at short distances from relatively easily accessible forest areas. Production techniques - though still poor - are generally more advanced than in the *várzea* forests, as the use of mechanized equipment is more widespread. The local economy in the colonization areas is not based on barter but is almost fully monetized. Traditional mercantile relations are much less pronounced and, in addition to the external demand, there is also a local demand for timber for houses, fences and agricultural tools.

4.4 Land and tree tenure arrangements

The last aspect of timber extraction to be dealt with in this chapter is the tenure of land and trees which are exploited for timber. The ownership relation to the tree or forest resource to a large extent determines how the forest and trees are utilized, who is responsible for their management and how benefits are distributed (Wiersum, 1988/89; Bruce & Fortmann, 1988).

In the Amazon region, forest and trees can be 'owned' by (1) the community as a whole, when forests are public domain (*terra devoluta*) (2) the state (e.g. the National Tapajós Forest), (3) private landowners, large and small, who have not yet brought all their land into cultivation or (4) by land squatters.[12] Private ownership prevails in the colonization areas such

12. In the Amazon, land occupiers are usually divided into land squatters (*posseiros*) and large estate swindlers (*grileiros*). The difference lies in the scale and intention of the action. Whereas the *posseiro* occupies a small plot of land for subsistence farming, the *grileiro* does so driven by land hunger and speculation. It is far from easy to fit the

as our study area, whereas the public domain can be found in the *várzea* forest and the more isolated parts of the upland forests. Land squatters are most likely to be found at the fringe of official colonization areas but, in the case of sawmills also along the river banks in the interior.

The owner is not necessarily the user or exploiter of the forest, as land can be rented out or given in use for logging. In the latter instance a sawmill or lumberman is what Wiersum (1988/89) calls a 'user by permission'. The landholders, whether a small peasant or a large estate owner, are paid for the right to extract wood from their land, i.e. the area which has not yet been deforested. The price to be paid differs according to the number of trees to be harvested, the commercial value of the timber species and the distance to urban centres. In the case of arrangements between sawmills and small landholders there is often no money involved. Usually, they exchange the trees for sawnwood, but it can also be arranged that the sawmill constructs a secondary road (*ramal*) or lends a tractor or other machine. If roundwood is exchanged for sawnwood the usual deal is to return a percentage of between 20 and 30% of the sawnwood output to the owner of the trees.

Agricultural colonists sell the wood from the forest which they intend to clear for agriculture or the wood which is left after bringing the land into cultivation. For a long time, forests have been cleared for agricultural purposes without utilizing their wood resources. The trees were burned for ash to provide nutrients for the generally poor soils. As late as 1979 less than 0.5% of the standing wood volume was used for timber or fuel (Rankin, 1985, citing Myers, 1980). A more recent study on clearings in Rondônia indicates that only 3-6% of the standing wood is exploited (Groeneveld, 1987).

For various reasons, the wood resources of forests which are to be transformed into farming land have been utilized to a greater extent during the past few years. With regard to the colonization areas in the Santarém region, this can be explained by the increased demand for logs and wood products which have made timber rise in value. This demand originated from three sources. In Itaituba, a small town located along the Transamazônica on the banks of the Tapajós river, demand boomed as gold

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sawmills into one of these categories. In scale they cannot be compared with *posseiros*; while their intention is, in general, primarily prompted by the objective to reserve a timber source for the future and not by greed for land or speculation.

mining developed. Colonists along the Transamazônica and Santarém-Cuiabá road began to improve their houses. A few large companies from Santarém began to buy export timber from the sawmills in the interior as these species had become increasingly scarce in the direct neighbourhood of the city. In this way they created a new market for the most valuable timber species. The growing demand for timber provoked an increase in the number of sawmills in the colonization area and created an outlet for roundwood which would formerly have been destroyed to make way for agricultural land uses.

At current prices, however, the peasants are still reluctant to sell trees from their forest reserve.[13] They generally prefer not to sell more of these trees than is required to use as exchange for what they need at that moment. To the peasants the trees represent a reserve of capital for unexpected or extra outlays and a means of broadening their subsistence when agriculture alone does not provide enough to be able to survive.

The owners of large estates sell the timber with a commercial value or the right to exploit their forest in order to finance the sowing, extension or improvement of pasture. In Amazonia pasture is generally exhausted after eight years and its improvement is not economically viable under existing management practices (Poelhekke, 1984). The selling of logging rights before cutting down and/or burning all the vegetation, has been gaining in importance, as large landholders have recently been faced with less institutional support for cattle raising (Uhl et al., 1991 and 1992).

The tenure situation under which logging takes place is related to the kind of actor involved, the scale on which he operates and the region where he works. Lumbermen of the *várzea* generally exploit tracts of forest which are public domain. The lumberman of the upland forests generally works on private land. All the interviewed lumbermen logged the land of colonists who sell them the standing trees on the area which they plan to bring into cultivation. The trees are usually paid per individual piece (*comprar por árvore*) at prices varying from US$ 13-26 during September-October of 1989. In addition, some of the lumbermen (six out of nine) logged their own property, one of which consisted of seven holdings of 100 ha each. If the lumberman works exclusively as such, he will sell his land after it is

13. When colonists settled recently or when they lack the means to clear all their land, a large part of it still is virgin forest. Moreover, they are not allowed by the Brazilian Forest Act to deforest more than 50% of their holding.

logged out and buy another plot of land which has not yet been deforested. If he is an agricultural colonist he will cultivate the area after logging it. As most lumbermen operate on a small scale, it is very unusual for them to deal with big landowners.

The forest tracts that are exploited by the sawmills are also covered by different forms of land tenure as can be seen in Table 4.5. Virgin forest which is public domain (*terra devoluta*), is exploited by five timber companies from Santarém city, one sawmill along the Transamazônica and one company from Belém. As far as the Santarém region is concerned, these areas are located on the banks of small rivers in the interior (Curuatinga, Curua Una). As the public domain in general lies far away from the cities and the roads, exploitation and transportation costs rise. It is generally the larger sawmills who undertake logging in these areas, as small producers lack the means to exploit large forest tracts which have not yet been opened up.

Exploitation of the public domain in isolated areas is only economically attractive if the sawmill needs highly valuable species such as mahogany which is scarce in the neighbourhood, or when the sawmill owner intends to claim the land as his own for future use. The latter is possible as Brazilian law acknowledges the right to land through its appropriation *(direito de posse)* by those who have lived on unclaimed public land and cultivated it for at least one year and one day. If the *posseiro* lives on and cultivates the land for more than ten years, he has the right to the land title (Foweraker, 1980). In practice, many large companies and speculators succeed in claiming land without having fulfilled the conditions of having to live on it or to cultivate it. For this reason, many of these sawmill-owners already consider these areas as their own.

A more common situation for the sawmills with their own logging operations located along the exit roads and Transamazônica and for the sawmills in Belém, is to exploit their own forests. The small sawmills in colonization areas which are operated by agricultural colonists, exploit the tracts of forest which are to be converted into farming land. Other sawmills operate and exploit forests on large estates where frequently cattle raising and/or commercial farming is also practised. Besides these operations, which are linked to agricultural land uses, sawmills can also extract roundwood from a tract of forest which is taken into possession or acquired formally for the exclusive purpose of timber exploitation. The latter also

includes a few management projects for the sustainable production of timber.[14]

Table 4.5 Tenure of roundwood sources

Tenure situation	Location and number of sawmills: Santarém (n=8)		Exit roads (n=9)		Trans-amazônica (n=19)		Belém (n=5)		Total (n=41)	
Public domain / land occupation (*posse*)	5	63%	-	-	1	5%	1	20%	7	17%
Private ownership	2	25%	5	56%	9	47%	4	80%	20	49%
Trees of colonists	3	38%	5	56%	17	90%	-	-	25	61%
Logging rights on large estates	1	13%	-	-		-	2	40%	3	7%

Note: Column totals do not amount to 100% as a sawmill can exploit various areas under different tenure systems.
Source: Author's field research, 1989.

Sawmills also exploit forest on the land of colonists and large landowners. Small sawmills, which operate on a scale comparable to lumbermen, make arrangements with colonists to exchange trees for sawnwood, road construction or machine loans. For the sawmills along the Transamazônica this is the most common tenure situation they deal with, along with logging on their own properties. For large companies, such as those from Belém, it is not in their interest to deal with colonists as these minor supplies are out of all proportion to the large amounts of roundwood they need. Because of this, they usually negotiate logging rights with the owners of large estates.

4.5 Summary

In this chapter, we have seen that the Amazonian timber industry exploits the forest selectively, utilizing at most 10% of all timber species. In the Santarém region no more than fifty timber species are used. Production of

14. A project for sustainable logging is required by the Brazilian Forest Act when the consumption of raw material exceeds 12,000 m^3 a year.

most sawmills focuses on less than ten species. Which species are used depends on the market to which the sawmill is oriented and on the location of its roundwood source. With regard to the location aspect, the distinction between *várzea* forests along the rivers and non-flooded upland forests (*terra firme*) is essential.

Traditionally, timber extraction was concentrated in the *várzea* forests but currently, an estimated 85% of all roundwood originates from upland forests in recently opened and occupied areas. As a result, much roundwood is now supplied from tracts of forest which are to be converted into farming land and pasture. Wood from clearings for agricultural land uses makes up 71% of all roundwood inputs of the sawmills in our study area and 49% of total log consumption of the surveyed companies in Belém.

Another feature of timber extraction in the Amazon is the different scale and technological level of existing logging operations. We described traditional, virtually manual logging practices, which are still to be found in the *várzea* and isolated upland forests. We also described semi-mechanical operations with the use of chain-saws and logging trucks in the upland forests. Finally we looked at large-scale operations which use specialized forestry equipment and which are only undertaken by some of the largest companies.

The principal actors involved in logging are the sawmills and independent lumbermen. The lumbermen play an important role in the roundwood supplies of the Amazonian timber industry. In 1989, they provided 80% of all roundwood used by the sawmills included in our survey. We have seen that lumbermen from the *várzea* and upland forests work under different conditions with respect to the extraction process, log transportation and their relationship to the sawmill.

With regard to the second group of actors - logging crews employed by sawmills - we distinguished between three levels of operation and technology. Whereas at the low and medium level two to four men work together in a small team, at the highest level 20-30 men work under a rigid division of labour, conditioned by the machines and instruments available. The high costs and organization involved in these logging operations is one explanation of the preference of sawmills for buying logs from lumbermen.

Another reason for the important role of lumbermen must be sought in the traditional labour relations prevailing in the Amazonian extractive economy, known as the *aviamento* system. Under this system, the extractor receives an advance in merchandise, tools and/or money in exchange for the

physical product at the end of the expedition. Many conditions under which this system originated still prevail in the timber economy. Hence, these labour relations are still widespread, whether or not their form has been adapted.

The relationship of the sawmill to the source of roundwood is not only indirect because of logs being supplied by intermediaries but also because it is quite common for both lumbermen and sawmills to log areas owned by others. Agricultural colonists exchange trees for money, sawnwood, road construction or machine loans. For both peasants and cattle-raisers the selling of trees or logging rights provides financial or technical means for the conversion of forests into farming land or pasture.

To sum up, it can be said that the conditions under which roundwood is provided does not make a sound basis for the sustainable management of forest resources. Most sawmills have no direct links to their roundwood sources and where they do they are, in many cases, also involved in agricultural activities. Sawmills directly engaged in logging with the primary purpose of timber exploitation are only a small minority.

5 The timber industry and the sustainable development of Amazonia

There has been a lot of controversy about the potential role of the timber industry in the sustainable development of the Amazon.[1] Whereas in some governmental reports forestry is depicted as being the 'real vocation of the Amazon' (e.g. Pandolfo, 1974), others have ventilated severe criticisms of the sector's alleged role in the destruction of the tropical rain forest (e.g. Valverde, 1980 and 1990). In the first part of this chapter we will look at the ecological effects of logging operations. Next, we will turn to the prospects of sustainable forest management in the Brazilian Amazon. The first aspect to be dealt with is the technical feasibility of forest management for the sustainable production of timber. We thereby briefly review the available techniques for sustained yield forestry and the initiatives undertaken in this field in the Amazon. Subsequently, we will examine the institutional framework necessary to protect the forest, to control its exploitation and to promote sustainable forest management. We will finally discuss the prospects for the application of ecologically sound logging practices on a commercial scale.

5.1 The ecological effects of logging operations

On a global scale, commercial logging is considered to be an increasingly important cause of the deforestation in the tropics. According to estimates referring to the first half of the 1980s, the undisturbed closed forest annually logged amounts to approximately 44,000 km^2 (FAO, 1982).[2] Myers (1984) adds around 6,000 km^2 to this figure which are logged illegally each year. Of the legal fellings, 21,000 km^2 take place in South and Southeast Asia, 17,500 km^2 in Africa and some 15,500 km^2 in Latin America (Myers, 1984).

Although the FAO (cited in Jonsson & Lindgren, 1990) attributes 15% of all deforestation in the tropics to timber exploitation, it is hardly possible

1. Sustainable development is used here in the sense defined in the Brundtland Report: 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (WCED, 1987).
2. Data referring to 76 tropical countries, which, together, cover 97% of the total area of tropical countries.

to relate the aforementioned figures to data on total forest destruction. Except for a few cases of what is called 'full forest harvesting', timber exploitation is highly selective.[3] As long as it does not result in clear-cutting, logging is not included in estimates on forest losses by, for instance, the FAO. Another reason why it is difficult to assess how much of the total deforestation can be attributed to commercial logging is its interrelation with clearings made for agricultural purposes.

When logging facilitates access to the forest, it can turn into the major indirect cause of deforestation. This is the case in areas of high population pressure such as Southeast Asia and West Africa. Landless peasants pour in along the logging roads after the loggers have left and convert the remaining forest into cropland. In the colonization areas of Amazonia, negotiations on logging rights or felled trees may provide the financial means or the farm machinery needed to bring the land under cultivation and thus produce a multiplier effect on deforestation.

The prevailing relationship between logging and clearing for agriculture in Amazonia is, however, the inverse process. As seen in Chapter 4, commercial logging is more often a side-effect of the colonization process than a catalyst for further deforestation.

In both cases it is difficult to make a clear distinction between the area that is deforested as a direct or indirect result of commercial logging or as a consequence of clearing for farming or grazing.

According to data published in 1989 by the National Institute for Spatial Research (INPE), by 1988 deforestation in the Brazilian Amazon had amounted to 251,430 km^2 or 5.12% of the total territory of the Legal Amazon. This figure does not include areas deforested prior to 1960.[4] When the older forest losses are included and conversion is not related to

3. 'Full forest harvesting' denotes the use of an enormous chipping machine which is able to remove five hectares of forest per day, reducing all trees entirely to small chips for use in paper and cardboard production. Chipping has already been put into practice in Papua New Guinea. In Amazonia it is only used on the Jarí project for selected native species as a supplement to the plantation pulpwood (Myers, 1984; Fearnside, 1989).
4. The older conversion of forest into other land uses refer mainly to the Bragantina zone in northeastern Pará, which was occupied between 1820 and 1920.

the total land area but to the area of original forest cover, deforestation had reached 12% by 1988 (Mahar, 1990).[5]

A review of the literature on the causes of deforestation in the Amazon shows that commercial logging - despite its increasing importance - is not yet among the major causes of the destruction of the Amazonian rain forest. Deforestation in Amazonia is largely the result of - present or past - government policies and the transfer of socio-economic problems from the rest of Brazil. Government policies included the construction of roads without proper land-use planning, the subsidizing of large cattle ranches by tax incentives, the promotion of migration by landless peasants and the establishing of gigantic projects for the exploitation of the region's mineral and hydroelectric resources.[6] Their destructive effects have been reinforced by underlying social and economic problems such as:

- a highly unbalanced distribution of land tenure and the persistent concentration of landownership which has resulted in the displacement of small and landless farmers from northeastern and southern Brazil to the Amazon;
- land conflicts in which deforestation is used as a strategy to claim the right to land (Chapter 6);
- a structurally high inflation which encourages the purchase of forest land and cattle as secure investments;
- a huge foreign debt which induces an export-oriented policy based on large-scale exploitation of the country's natural resources.

All this is not to say that logging, as practised in the Amazon, is innocuous. Data presented in Chapters 3 and 4 has shown that roundwood production in the entire Amazon amounted to 50,145,998 m3 in 1989 (Table 3.2). We also estimated that 85% of all roundwood currently comes from the upland forests, which contain 60 m^3/ha of commercial timber, on average. The

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5. Adding to this the forests that are damaged without being cleared, the total percentage of the Brazilian Amazonian forest affected by degradation processes is estimated at 24.9% (Valverde, 1990).

6. The impact of the Brazilian government policy on deforestation has been described by Browder (1988), Binswanger (1989) and Mahar (1990). For a general review of the causes of deforestation in the Amazon see Fearnside (1988 and 1989), Lutzenberger (1987) and Hecht & Cockburn (1989). The impact of cattle ranches has been described by Hecht (1983 and 1989) and Poelhekke (1984). For more information on large government projects, see the work of Pinto on Carajás (Pinto, 1982) and Jarí (Pinto, 1986), various contributions in Kohlhepp (1987) and da Costa (1987) and a brief review by Neto (1990).

amount of marketable timber in várzea forests amounts to 30 m^3/ha (Pandolfo, 1979). These data suggest that - irrespective of the association between logging and clearing for agriculture - a total area of approximately 9,600 km^2 or 0.3% of the total Amazon forest has been affected by timber extraction in 1989 alone.[7]

Though small-scale exploitation by lumbermen still predominates, the number of large-scale operations with the use of heavy machinery is steadily increasing. The ecological effects of these operations have been studied by various authors, mainly in Southeast Asia (e.g. Kartawinata, 1977; Suparto et al., 1978; Abdulhadi et al., 1981; Marn & Jonkers, 1981; Johns, 1988), but also in Surinam (Jonkers, 1987; Hendrison, 1990). In Amazonia, pioneer work in this field has been undertaken by Uhl & Vieira (1989), Uhl et al. (1991 and 1992) and Veríssimo et al. (forthcoming). These studies indicate that the ecological effects of uncontrolled logging as such, aside from its indirect effects on subsequent settlement, can be divided into several aspects:

1. *The loss of trees which are harvested.* This effect is the least severe of all. The Amazonian studies by Uhl et al. indicate that no more than 4-8 trees per ha (1-2% of the total number of trees) are harvested. Even in the more homogeneous forest of Southeast Asia the percentage of trees that is harvested per unit area does not exceed 10%.
2. *The loss of trees which are killed or injured beyond recovery.* The harvested trees are likely to pull others down in their fall because they are linked together by lianas, climbing plants and their wide-spreading crowns. For the same reason, residual trees may suffer irreparable crown damage. As a result of hauling or skidding, trees may get uprooted or injured beyond repair by passing bulldozers. In a tropical rain forest, even minor bark damage may result in the death of a tree as it can facilitate the entry of fungi (Tinal & Palenewen, 1978) and increase the tree's susceptibility to disease (Myers, 1982). The aforementioned chain-effect and bark damage together may destroy one third to more than half

7. In comparison: annual conversion of forest into pasture is estimated at 8,000-10,000 km^2 and that of forest into cropland at 2,000 km^2 per year (Mahar, 1990). Total deforestation amounted to approximately 18,500 km^2 per year during the second half of the 1980s (INPE, 1989).

of the trees. Veríssimo et al. (forthcoming) found an average of 35% of the trees damaged in three logging sites in Paragominas.

3. *The loss of vegetation removed for the construction of logging roads and log-loading areas.* In the studies of Uhl & Vieira (1989), Uhl et al. (1991) and Veríssimo et al. (forthcoming), as much as 8-14% of the exploited forest was cleared for logging roads and loading areas to extract the felled trees. Surveys undertaken in Southeast Asia indicate that up to 30% of the forest area might be covered with logging roads and loading zones (Jonsson & Lindgren, 1990). Aside from the loss of vegetation the bare soil increases erosion and surface run-off.
4. *The loss of biodiversity and genetical erosion.* Selective exploitation implies that the species with the highest commercial value are likely to be overexploited and could be threatened with extinction. In Amazonia several species are already increasingly difficult to find such as mahogany (*Swietenia macrophylla*), cedro (*Cedrela odorata*), maçaranduba (*Manilkara huberi*) and cerejeira (*Torresea acreana*) 'Genetical erosion' means that trees with the best genetic qualities are felled and the regeneration of the species then rests with the biologically inferior specimens which remain in the forest (Lisboa, 1986).
5. *Soil compaction as the result of heavy machines.* Bulldozers and skidders have a serious compacting effect on forest soils, reducing porosity, aeration, infiltration and its water retention capacity. The penetration of roots is seriously hampered and the regeneration capacity on skidding trails - which might occupy 14-16% of the total logged area - might be severely reduced for many years (Hendrison, 1990).
6. *Impact on wildlife.* Contrary to the dipterocarps logged in the forests of Southeast Asia, some of the trees exploited in Amazonia are important food sources for animals. Though wildlife can resist light selective logging, intensive logging results in a disproportionate loss of major food sources and can severely reduce the number of animal species (Johns, 1986 and 1988). Maçaranduba (*Manilkara huberi*), a frequently harvested tree species in Pará is an example. It produces a fruit which is consumed by parrots, monkeys, agouti, deer and turtles. Over-exploitation of this species might well result in the local extinction of some animals (Uhl & Vieira, 1989).
7. *Increased susceptibility to fires.* Whereas primary tropical rain forests are fairly resistant to fires, selective logging may turn them into fire-prone ecosystems. The gaps in the forests allow for more radiation to

reach the forest floor which thus decreases relative humidity. This may quickly dry the many potentially combustible bits of wood which remain on the ground after logging. With logging roads and skidding trails providing a route, fires from surrounding forest areas burned for pasture or cropland can then easily spread into the selectively logged forest (Uhl & Buschbacher, 1988).

To sum up, 'selective' logging would imply a minor impact on the forest when seen from the number of harvested trees per unit area.[8] But, as several surveys in the Amazon have shown, current exploitation practices imply destruction and irreversible damage to 26-49% of the forest in order to extract, at most, 3% of all trees. In addition, logging negatively affects biodiversity, wildlife and the fire-resistance of the rain forest. Some observations with respect to this statement need to be made, however.

In the first place, the ecological impact of logging operations varies considerably according to the number of trees cut per ha and the techniques employed (Marn & Jonkers, 1981; Johns, 1988). Virtually all studies on the ecological effects of logging refer to uncontrolled mechanized operations. Only the Tailândia case of Uhl et al. (1991) refers to loggers working with only trucks and chain-saws. Then only 11% of the total number of trees with 10 cm and more diameter at breast height (dbh) were damaged.

As we have seen in the previous chapter, only 20% of the raw material consumed by the surveyed sawmills in 1989 was provided by their own logging operations and only 24% of the sawmills engaged in logging employed techniques comparable with the situation in the aforementioned studies. Eighty per cent of the logs were supplied by lumbermen who work on a small scale with manual or semi-mechanized methods. Hence, the

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8. As to the harvest volume and logging damage foresters prefer to take the basal area rather than the number of trees as a point of reference. The latter is an inaccurate measure as it does not take the diameter of the trees into account. The basal area is defined as the sum of the cross-sectional areas of all trees per unit area measured at breast height (1.30 m). As the harvested trees belong to the largest trees, the percentage of the basal area which is harvested is considerably higher than the percentage of the total number of trees (19% versus 3% on average in the study of Uhl & Vieira, 1989). Logging damage, on the other hand, is more likely to occur in the smallest trees and consequently is lower when expressed as a percentage of the total basal area than when it is expressed as a percentage of the total number of trees. Although this gives another impression of the proportion of harvested to damaged trees, the actual total damage is virtually the same (a total damage of 57% when related to the total number of trees and 51% when related to the total basal area in the case of Uhl & Vieira, 1989).

ecological impact of the majority of logging operations in the Amazon region cannot be compared with those of the mechanized operations.

In the second place, logging in Amazonia is strongly linked with the colonization process. The previous chapter showed that 50-70% of all raw material was provided from clearings. The volume and origin of roundwood consumed by the sawmills in our study area in 1989 (cf. Table 4.1) would have affected 2,108 ha of forest with the average volumes of marketable timber per hectare mentioned above.[9] Of this area, 62.7% was destined to be cleared for agriculture.[10] The volume of roundwood utilized by the surveyed firms in Belém corresponded with the exploitation of 10,425 ha in 1989.[11] Of this total, 3,383 ha (32.5%) were to be cleared for agriculture and 7,042 ha (67.5%) were affected by logging per se. In other words, for two thirds of the exploited areas in the Santarém region and one third of the forest area logged by the surveyed firms in Belém, forest degradation cannot be attributed to logging as these tracts of forests would have been cleared for farmland or pasture in any event.

5.2 Forest management for the sustainable production of timber: methods and experiences in the Amazon

Logging damage can be substantially reduced and sustained yields can be achieved through the employment of ecologically sound logging techniques. Much confusion exists, however, about what 'sustainable rain forest logging' actually means and how it should be applied. In the first part of this section we will present some notions on the concept of sustainable forest management and a general description of existing methods. The

9. The average volume which is actually harvested per hectare is lower (35-50 m^3).
10. The total area of logged forest was calculated by dividing the volume of harvested roundwood by the average volume of commercial timber per hectare as given in Pandolfo (1978). The volume of roundwood from clearings amounted to 79,313 m^3, involving an area of 1,322 hectares at an average of 60 m^3/ha. In addition, 16,800 m^3 was logged in upland forests independent of clearings (280 ha) and 15,180 m^3 came from *várzea* forests, which corresponds with 506 ha at an average of 30 m^3/ha.
11. A volume of 210,960 m^3 came from *várzea* forests, corresponding with 7,032 ha (average 30 m^3/ha) and 203,262 m^3 came from tracts of upland forest which were to be cleared (3,371 ha 11.1214 by 60 m^3/ha).

second part provides a description of three pilot projects on forest management, which are all located in our study area.[12]

5.2.1 The concept of sustainable forest management

One of the definitions of sustainable forest management has been provided by Maini (1992), who stated that the concept 'involves maintaining indefinitely, without unacceptable impairment, the productive and renewal capacities as well as the species and ecological diversity of forest ecosystems'. This definition reflects the controversy that is implied in the concept of sustainable forest management. What has to be sustained and to what degree damage is acceptable is the subject of considerable discussion.

Environmentalists have argued that 'sustainable logging' is a myth (Anderson, 1989; Colchester, 1990). The main reason for this standpoint is that a study for the ITTO has demonstrated that merely one tenth of a percent of all productive tropical forests is currently being managed for the sustainable production of timber on an operational scale (Poore, 1989). In addition, it is argued that sustained-yield logging does not allow for the preservation of biological diversity and genetic resources, nor for the exploitation of non-timber forests products which are essential for the survival of the indigenous people (Anderson, 1989; Colchester, 1990).

Foresters, on the other hand, consider forest exploitation to be sustainable when the productive capacity and the essential ecological character of the forest are maintained (Schmidt, 1987). The essential ecological character of the forest tends to be interpreted in terms of heterogeneity of ages and species, the capacity for natural regeneration and soil protection through continuous forest cover.

This controversy makes clear that forests can be managed to different ends in accordance with their different ecological, economic and social functions. The problem lies in the spatial incompatibility of preservation and intensive economic utilization. The preservation of ecosystems,

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12. A fourth experiment in the Brazilian Amazon was initiated in 1989 in the Antimari National Forest in the state of Acre. This project, carried out by the Technical Foundation of Acre (FUNTAC) is still in an exploratory phase. Research is being conducted into forest management for timber and non-timber forest products, wildlife and agroforestry. The project aims at developing appropriate management technology to be applied through local communities of rubber tappers and small farmers (Perl et al., 1991).

indigenous living areas or the protection of watersheds require minimal intervention which is incompatible with large-scale timber exploitation. Logging, on the other hand, leads to modifications in the structure and the composition of the forest which are detrimental to biological diversity and genetical resources.

One of the main challenges to forest management is finding the balance between satisfying the demand for forest products, living space for indigenous people and the preservation of ecosystems. In order to achieve this, it is necessary to specify the management objectives and to design a management strategy in accordance with each specific purpose (Poore, 1989). For successful forest management comprehensive land-use planning is needed which can specify the parts of the forest designated for preservation and utilization. Aside from timber production, traditional land-uses, farming and other non-forest uses are also to be taken into account as possible options for economic utilization (Wyatt-Smith, 1987; Poore, 1989; Jonsson & Lindgren, 1990).

If a tract of natural forest is set aside for the sustainable production of timber, there is no one, single management strategy. In fact, several methods exist, with varying degrees of intensity. In general terms these can be summarized as follows (Schmidt, 1987; Poore, 1989; Buschbacher, 1990; Jonsson & Lindgren, 1990):

1. *Demarcation and no activity ('wait and see'):* a tract of forest is demarcated and protected from encroachment in order to reserve a timber resource for the future when market and other conditions allow sustainable management. Some authors, such as Poore (1989) consider the Tapajós National Forest in our study area to be an example of this strategy. This forest was demarcated for the sustainable production of timber but the original management plan is not considered to be economically viable due to the supply of cheap logs from clearings in the neighbourhood (see 5.2.2 for more details).
2. *Log and leave:* a forest is logged in accordance with a previously established harvesting plan based on an inventory of species and diameters. After the logging operation, the forest is left to recover without further treatment. To be successful, this system requires control over the forest area and frequent monitoring of the regeneration.
3. *Light selective logging with minimum intervention:* an inventory is made and harvest is planned through the marking of trees, roads and skid trails. After careful felling and extraction, the forest is closed. Cutting

cycles and logging intensity are defined in accordance with silvicultural principles.

4. *Light selective logging and silvicultural treatment:* in addition to harvest planning, regeneration and growth are enhanced through silvicultural treatments such as liberation thinning (poison girdling of undesirable trees, the cutting of lianas and vines and the removal of competing brush in order to give space to the natural regeneration and existing trees of desired species).[13] This strategy is the basis of the CELOS management system, which is described in more detail in Appendix 4.
5. *Light selective logging and enrichment planting:* after logging, saplings of desired species are planted to promote regrowth where natural regeneration is considered to be inadequate.
6. *Intensive logging and silvicultural treatments:* through intensive logging, the elimination of undesirable vegetation and continuous weeding and thinning, a more homogenous forest is created with a limited number of commercial species and trees of similar age. Examples are the Tropical Shelterwood System developed in Ghana and Nigeria and the Malaysian Uniform System, developed in the lowland dipterocarp forests of Malaysia.
7. *Strip clear-cutting:* based on the dynamics of regeneration in natural gaps, this system implies the complete harvesting of all woody material in long narrow strips in the forest. It is thereby presumed that the nearby vegetation will provide the seeds for regeneration. The regeneration is thinned afterwards. This system is being tested in the Palcazú valley in Peru. More details on this experiment are presented in Appendix 4.

Each system has been developed in a specific context and cannot simply be transferred to another location without due consideration being given to the local characteristics of the forest and the prevailing socio-economic conditions. For the Amazonian situation, the CELOS management system and the strip clear-cutting system are considered to offer the best prospects (Jonsson & Lindgren, 1990; Dykstra & Heinrich, 1992). Both systems are described in more detail in Appendix 4.

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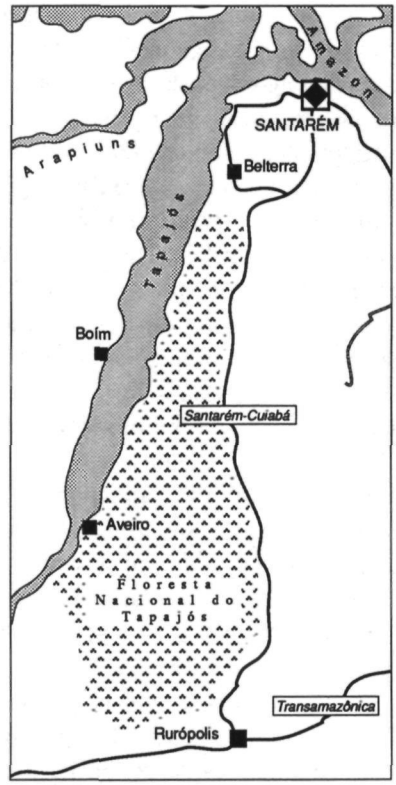
13. Poison girdling is the administration of an arboricide in a kind of channel which is cut over the whole circumference of a tree and which makes an angle of 45 degrees with the vertical (Jonkers & Schmidt, 1984).

5.2.2 Pilot projects in the Santarém region

Several efforts have been undertaken to develop natural forest management systems, which are suitable for the Amazon region. In this section we will describe three pilot projects located in our study area, in order to illustrate some of the difficulties and the potential for sustainable forest management in the Brazilian Amazon. The first project to be described is the plan to manage the Tapajós National Forest for the sustainable production of timber. It was intended that the Brazilian forestry service IBDF (predecessor of the IBAMA) and the local timber industry carry out this plan under a system of licensing. The second project is a research programme on natural forest management carried out at the Curua Una experimental station by the SUDAM and the Faculty of Agricultural Sciences of Pará (FCAP). We finally consider the research programme at the experimental station of Belterra, which is being carried out by the Brazilian Enterprise for Agricultural Research/Centre for Agricultural Research in the Humid Tropics (EMBRAPA/CPATU). In contrast to the other two projects, the programme at Belterra is not directed towards the management of natural forest but is aimed at the regeneration of degraded areas and secondary forests.

The management plan for the sustainable production of timber in the Tapajós National Forest was the first, and until 1989 the only plan designed for the exploitation of a National Forest. The Tapajós National Forest covers a triangular area of 531,000 ha between the Santarém-Cuiabá road and the Tapajós river. Its northern margin is located 50 km south of Santarém and in the south it is bordered by the rivers Cuparí and Santa Cruz, slightly north of the Transamazônica (Map 5.1). During the 1970s, the IBDF made various forest inventories of the area and carried out research on silviculture, wood technology and forest exploitation in co-operation with the FAO, EMBRAPA and SUDAM. During the late 1970s, the IBDF and the FAO undertook a feasibility study of a combined forest management and wood-processing industry project (Nascimento, 1985). On the basis of its results, the IBDF developed the management plan for the Tapajós Forest which was published in 1980 (IBDF, 1980).

According to the management plan, only one third of the total national forest (171,400 ha) is available for timber exploitation as the remaining area consists of unproductive forests and farming land. Within the available area,



Map 5.1 The Tapajós National Forest.

only 136,120 hectares can be effectively used for sustained forest management.[14]

The net volume of commercial wood species has been estimated at a mean of 40 m3/ha. In the management plan, the IBDF aims at roundwood production of 150,000 m^3 per year. To this end 3,900 hectares would be annually liberated for exploitation. To guarantee sustained yields,

14. Part of the management area of the Tapajós National Forest is already being used for military purposes (13,000 ha), agriculture (5,000 ha), villages (4,000 ha), experimental areas (180 ha) and a phenological park (400 ha). Another part is destined for biological reserves (3,500 ha), protection of river banks (600 ha) and a second phenological park (500 ha). The remaining area (approximately 7,500 ha) is considered unproductive as it contains less than 5 m^3 marketable timber per hectare.

approximately one third of this area is to be managed on the basis of natural regeneration with silvicultural treatments whereas the remaining area is to be enriched by the planting of selected commercial species.

Analogous to the Schmithüsen plan described in Chapter 2, the management plan for the Tapajós National Forest intends to have the forest exploited by timber companies under a licensing system. The logging operations are to be carried out in conformity with a management plan, which has to be approved by the IBDF. The firms should also submit a proposal for integrated industrial wood processing as Pandolfo had had in mind. According to the conditions of the licence, the IBDF would be charged with the supervision of the logging operations and with the silvicultural treatments after the harvesting operation.

The timber company would pay a fee in accordance with the volume of harvested wood, a fee to cover the administration costs of the licence and a contribution to the management costs (Nascimento, 1985). The licence would be granted for ten years and could be renewed after then.

The plan has been executed on a very modest scale. So far, only 4,000 ha have become available for exploitation. The IBDF prepared 1,000 ha for commercial logging. The institute made an inventory of the standing timber, constructed access roads and divided the area into ten sections of 100 ha each. Subsequently sawmills and timber companies were able to apply for logging licences but only one company actually participated in the programme. Others considered the price of the licence too high and the wood quality too low and they were not very keen on collaborating with the IBDF and exploiting the forest on such onerous terms. The IBDF nevertheless intended to have the other 3,000 ha exploited in the near future.

The limited success of the management plan has been ascribed to the weak structure of the IBDF and uncertainty about future forest policy (Nascimento, 1985). Poore (1989) attributes its lack of success to the opportunities for unrestricted logging at minimum costs in the surrounding colonization areas, where land is being cleared for agriculture. The involvement of several government agencies, who have limited collaboration between them and the cuts in their budgets are other factors that play a role. As a result of its lack of success, the project has been cited as an example of 'wait and see' management (Poore, 1989).

The management plan for the Tapajós National Forest was developed on the basis of research and trials carried out at the experimental station of Curua Una and at three experimental plots in the forest itself (km. 67, 83 and 117). Silvicultural research at Curua Una was initiated in the late 1950s under an agreement between the SUDAM and the FAO. The research programme is now the joint responsibility of the SUDAM/CTM in Santarém and the Faculty for Agricultural Sciences (FCAP) in Belém (Rankin, 1985; Poore, 1989).

Initial research was focused on the prospects for natural forest management systems based on both natural regeneration and enrichment planting. Surveys have been carried out to obtain information on the natural regenerative capacity of the forest and on the species suitable for enrichment planting or plantation forestry (Rankin, 1985). The results of the experiments with line and cluster planting at the Curua Una experimental station have been rather disappointing (Fearnside, 1983). Seedlings often did not take, the costs of transporting them are high, as are the labour inputs required for planting, poison girdling and the periodic clearing of weeds and vines.

In a later phase, experiments focused on systems based on natural regeneration such as the Malaysian Uniform System (MUS) and the Tropical Shelterwood System (TSS). These systems have been tried out to test their suitability in the Amazonian forest (Yared et al., 1988).

The experience with the MUS did not produce an operational management system for the Amazon. Increased light levels in the understorey have often resulted in the invasion of weeds and vines rather than of the desired trees. Moreover, in the case of low densities of commercial species, the elimination of 'undesirable' trees may result in considerable nutrient losses (Fearnside, 1983).

The results of the TSS were more favourable, with promising densities of several commercial native species in the regenerated forest. After 25 years the volume of commercial species amounted to 25 m^3/ha (Yared et al., 1988 citing Jankauskis, 1988). However, this system too has the disadvantage of eliminating 'undesirable' trees with potential commercial value in the future and the increased susceptibility to disease and pests and possible negative impacts on wildlife associated with the increased homogeneity of species (Yared at al., 1988). Probably in connection with this, the latest experiments on forest management carried out by EMBRAPA/CPATU at km. 83 in the Tapajós National Forest refer to the

polycyclic management system based on natural regeneration and selective poison girdling (Dubois, 1990), similar to the CELOS management system developed in Surinam. On the basis of these experiments, foresters attached to EMBRAPA therefore now tend to recommend this system as a basis for forest management in the region.

The last project to be mentioned here is the research on the regeneration of degraded areas and secondary forest at Belterra. Contrary to the aforementioned experiences, this project does not refer to the management of natural forest. However, the research on the prospects for reforestation of degraded pasture is relevant for the sustainable development of the Amazon region as 30% of the areas converted into pasture have become unproductive (Yared et al., 1988).

Table 5.1 Current species trials at the experimental station of Belterra

Common name	Botanical name	Possible end-uses
Castanha do Pará	*Bertholletia excelsa*	Brazil nuts, sawnwood
Mahogany	*Swietenia macrophylla*	Sawnwood, veneer
Morototó	*Didymopanax morototoni*	Matches
Tatajuba	*Bagassa guianensis*	Sleepers, naval construction
Parapará	*Jacaranda copaia*	Cellulose, matches, boxes
Taxi branco	*Sclerolobium paniculatum*	Veneer, plywood

Sources: Author's fieldwork, 1988; Yared et al., 1988.

The experiments which consist of trials with the planting of both native and exotic species are being carried out on a former rubber plantation established by Henry Ford in 1934.[15] As a consequence of cuts in funding, the number of species to be experimented with had to be reduced from 80 as had been originally intended to 40 and eventually to six (Table 5.1). The seedlings are cultivated in a nursery and planted in the open space on an abandoned pasture which covers a total area of 60 ha. The increase in length and diameter and the behaviour of the trees are carefully monitored by biannual measurements. Up to 1988, when we visited the experimental

15. Belterra still produces some rubber but, due to the neglect of the plantation since 1945 when Ford sold it to the Brazilian government, production has steadily declined.

station, reasonable results had been obtained with morototó (*Didymopanax morototoni*), tatajuba (*Bagassa guianensis*) and parapará (*Jacaranda copaia*). Due to problems associated with monoculture, however, experts do not yet consider the reforestation of degraded pastures a viable option (Gibson, personal comment, 1988).

In addition to the experiments with reforestation of degraded pasture, activities at Belterra also consist of enrichment planting in secondary vegetation (*capoeira*) to increase the economic value of secondary forest. Experiments comprise of a total of 19 tree species planted according to different techniques. Research aims at establishing the most promising species and planting techniques. Good results, in terms of annual increases in diameter, have been obtained with freijó (*Cordia goeldiana*) (Yared et al., 1988).

The impact of these projects on the logging practices of the timber industry has been limited until now. The results of research are rarely get disseminated and most sawmill owners are not familiar with them. In spite of their location close to the projects described above, 80% of the sawmill owners and managers interviewed had never heard about the research programmes at the experimental stations of Curua Una and Belterra. Only a few owners of medium-sized and large sawmills admitted to making use of the results of these projects in the design of their own management plans (five respondents in total (7.1%), of whom four applied the findings of Curua Una and three those of Belterra). The other respondents who had heard of the projects - ten in total (13.9%) - either saw no direct relevance of the programmes to their own situation or even believed that they had no relevance at all.

The pilot projects described in this section illustrate the complexity of developing and implementing sustainable management systems adapted to the specific conditions of the Amazon region. With respect to enrichment planting in particular, there are still many problems to be solved. Intensive management systems, which result in a drastic reduction of the number of species, do not seem to be appropriate for Amazonia. The recent trend among local forestry experts is to recommend systems based on natural regeneration and refinement.

The shelved management plan for the Tapajós forest and the limited impact of the research programmes on existing logging practices also illustrate that the mere availability of technically feasible systems does not guarantee the successful implementation of forest management. The socio-economic and political context appears to be of crucial importance.[16]

5.3 The institutional framework

One of the aspects generally considered to be essential for successful forest management is the institutional context of the exploitation and the conservation of tropical forests (Wyatt-Smith, 1987; Poore, 1989; Jonsson & Lindgren, 1990). This framework comprises of regulations for the use and protection of the forest resource, the institutions involved in the formulation and implementation of these rules and the wider policy with regard to forestry development. The principal regulations and institutions relevant to the timber industry in the Brazilian Amazon will be presented below. Subsequently, we will review efforts to develop a forest policy which is adapted to the specific conditions of the region.

5.3.1 The Forest Code of 1965

The basic legal instrument for protecting the forests both as an ecosystem and as a resource base, is the Forest Code (*Código Florestal* or *Lei 4.771*) of 1965. This law defines the areas where forest exploitation is prohibited in order to preserve their ecological value or to protect the livelihood of the indigenous population. It also regulates the basic conditions under which forest-based economic activities are permitted.

The first article of the Forest Code stipulates that ownership of forests can only be acquired under specific conditions established in law as they must be considered as assets for the common good of the entire population of the country.

16. This is not specific to the Brazilian situation. Various authors reviewing existing management practices in the world have come to the conclusion that sustainable exploitation systems are technically feasible but that their application is generally a failure as a result of socio-economic and political conditions (Schmidt, 1987; Poore, 1989; Buschbacher, 1990).

Next, the Forest Code qualifies certain forest tracts as permanent preservation areas where the exploitation of timber and other resources is forbidden. Among these areas are the forests located on river banks, at the source of watercourses, on slopes with a gradient of more than 45° and on the tops of hills and mountains. It is also forbidden to exploit forests with specific functions, such as the attenuation of erosion, the fixation of dunes or supporting the defence of the national territory. Other forests with a permanent preservation status are those located in indigenous areas.

In order to protect natural areas with exceptional characteristics and for educational, scientific and recreational purposes, the Forest Code provides for the creation of biological reserves and governmental parks on municipal, state and federal levels. In these areas economic exploitation is not allowed. For the economic utilization of forests, the government can create National, State or Municipal Forests.

The Forest Code requires every person or enterprise engaged in the extraction, processing or commercialization of forest products to be registered with the public forestry service (the present-day Brazilian Institute for the Environment and Renewable Resources - IBAMA). With respect to the exploitation of native forests in the Amazon region the Forest Code dictates the application of plans for sustained-yield forest management (article 15). Industrial enterprises which use large amounts of raw material are obliged to reforest new areas equivalent to the amount of raw material they consumed (article 20). Clear felling in the Amazon is only permitted provided that 50% of the rural property remains under forest cover (article 44).[17]

After the publication of the 1965 Forest Code several decrees and regulations were issued to specify the conditions under which the forest resources of the Amazon could be exploited. Of particular importance to the timber industry has been the *Instrução Normativa 001* (IN 001) of 1980 which stipulated the rules for forest exploitation and reforestation. With respect to logging operations in the Amazon, the directive stipulated that the primary forest could only be exploited under a management plan which had

17. Until 1989 this rule could be bypassed completely legally by repeated sales of smaller parts of the holding, a process referred to as 'the mathematics of destruction' (*a matemática da devastação*). An alteration of the law by which it is no longer allowed to divide property up into smaller units has made this practice illegal since 1989 (Kohlhepp, 1991).

been previously submitted to the IBDF. The plan should include a forest inventory, a harvest plan and a plan for transport. Trees should be selectively cut and the extraction of trees with less than 45 cm diameter at breast height was not allowed. The directive prohibited the felling of the Brazil nut tree (*Bertholletia excelsa*). Forest management could be based on natural regeneration with or without enrichment planting.

For the wood-processing industries, three options were available for meeting the requirements of reforestation. The basic condition was that four seedlings should be replanted for each cubic metre of timber extracted from the forest and this in the same federal state where the trees were felled. To that end, the enterprise could execute a reforestation project under its own control, contribute an equivalent value to a special forest restoration fund of the public forestry service or participate in reforestation projects carried out by specialized firms. If the enterprise did not undertake reforesting itself, it should buy a 'forest share' (*cota florestal*) for each 347 m^3 of sawnwood produced. Each forest share is the equivalent of approximately 25,000 seedlings, which have to be planted by the forestry service or by a specialist firm. In 1988, the price of one share amounted to approximately US$ 400.

In order to facilitate controls by the forestry service, each enterprise using, stockpiling, exporting, buying or selling wood products had to fill in a way-bill - the *guía florestal* - and a registration record on its monthly production. On these forms the volume produced, quantity transported, the species, degree of processing and the destination of the final product had to be specified. The way-bill had to accompany every log and timber transport. A sawmill could only receive a way-bill when it met the requirements on forest restoration. If timber was transported without the way-bill a fine could be imposed and the timber could be confiscated.

In October 1987, a decree - *Portaria n° 449* - was issued which obliged enterprises consuming 10,000 m^3 or more roundwood per year to have a management or reforestation plan under their own control to be undertaken in a forest tract which belonged to the company's property.[18] The same decree also prohibited the felling of the rubber tree (*Hevea* spp.), along with the Brazil nut tree. The use of chemicals in the exploitation and clearing of

18. The standard of roundwood consumption of a minimum of 10,000 m^3 implied the rectification of law n° 7,511 issued one year before which stated that a management plan had to be authorized by the IBDF for all forest industries.

forests was forbidden. In an attempt to curb the waste of timber when forests are converted to cropland or pasture, the decree formulated new requirements for the authorization of clear felling. For clearings up to 50 ha, it is necessary to specify how the woody material will be utilized. In other cases a forest exploitation plan has to be submitted. It is not allowed to clear more than 30% of the rural property in areas with a significant concentration of babassu palms (Guimarães, 1987).

The Forest Code and the regulations resulting from it, could not prevent the Amazon forest suffering severe losses in the last decades. Requirements with respect to reforestation are not adapted to the specific situation in the Amazon. The regulations allow for the replacement of natural forests for commercial monoculture but do not require that reforestation is undertaken in or near the forest that was logged (Lutzenberger, 1987). It was generally acknowledged that little, if any, money from the forest reposition fund had been invested in reforestation. Insofar as it was spent on concrete projects, it was mainly in the creation of National Forests, National Parks and biological reserves (Souza, 1988). The general impression is of laws which are systematically being infringed.

The poor functioning of the regulations can largely be attributed to the weakness of the Brazilian forestry service which is responsible for the implementation of forest policy and the control of forest-based activities.

5.3.2 The Brazilian forestry service: the IBDF/IBAMA

In order to enforce the Forest Code, the Brazilian Institute for Forestry Development (IBDF), precursor of the present Brazilian Institute for the Environment and Renewable Resources (IBAMA), was created in 1967 by merging together the National Pine Institute and the Department for Renewable Resources.[19] Its responsibilities included (1) the formulation of a forest policy, (2) the orientation, co-ordination and execution of measures necessary for the rational utilization, protection and conservation of renewable natural resources and (3) forestry development.[20]

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19. The National Pine Institute was established in 1941 as the answer to the over-exploitation of *Araucaria* forests in southern Brazil. It was responsible for reforestation, the promotion of new techniques in wood processing and the regulation of the Parana pine timber trade. The Department for Renewable Resources was created in 1962 to manage the National Parks and forest reserves.
20. Law n° 289 of February 28, 1967.

One of the tasks of the former IBDF and the present IBAMA is the monitoring of the exploitation of forest products and the regulation of the establishment and activities of wood-processing industries. Every person or enterprise engaged in the exploitation of forest products is therefore obliged to register with the forestry service and to account for the amount and origin of the roundwood utilized as specified in the previous section.

The forestry service has regional offices (*delegacias*) in every state which are responsible for research, reforestation, the management of national parks and forestry development in the area under its jurisdiction. In addition, there are auxiliary control posts, such as in Paragominas, Santarém and Itaituba in the state of Pará.

The structural problem of the former IBDF was its chronic shortage of funds, material and personnel, to perform its monitoring tasks adequately. As one of the officers in Brasília expressed it in 1988:

> 'We have 500 forest guards for the entire country. You can reduce this number by 20% because of those who are practically illiterate and by another 20% for those who are just serving out their time until retirement.'

In the period of our fieldwork, the IBDF employed only 40 forest guards for the entire state of Pará, which covers an area of 1,248,042 km^2. The working area of the Santarém office covers 150,000 km^2, but only three forest guards and three motor vehicles were available to control forest exploitation in the region. Due to lack of funds the agency was frequently without petrol. During the first seven months of 1988 it had to cover all its expenses with US$ 2,500. The office was not even able to check on all the enterprises in the municipality of Santarém not to mention the industries in the other municipalities in its working area.

As a result of understaffing and lack of finance the Forest Code and the resulting regulations have been neglected on a large scale. It is generally estimated that only 60-70% of the sawmills are actually registered with the IBDF. In our study area we found that only 40% of the sawmills were formally registered. Fraud and bribery were common practices. For example, it was quite usual to use a land title of a colonist to get the authorization for a logging operation and to use that authorization for other areas. It was also generally known that the sawmills in our study area did process the Brazil nut tree. Various sawmill owners along the

Transamazônica mentioned that guards from the local control post in Itaituba visited them once a year to collect their 'contribution'. If not paid, a fine was imposed for not being registered or for another 'contravention' of the regulations.[21]

Another problem with the IBDF was the lack of expertise in the regional offices for judging the quality of the management plans. It was generally acknowledged that political connections were more important to get someone appointed as head of a regional office than his expertise in forestry. The most well qualified officers used to work in Brasília where the policy was made.

Partly as a consequence of the poor functioning of the IBDF, the organization was dissolved in 1989 and transformed into the IBAMA. The new institute also absorbed the former rubber agency SUDHEVEA and the agency for fisheries SUDEPE. The integration of those organizations into a new one was not only an attempt to create a stronger organization but was also the result of the need to cut public expenditure. As the former IBDF, the IBAMA was made responsible for the co-ordination and execution of national policy and directives with respect to the preservation, conservation, rational utilization, control and development of natural resources.

The IBAMA was set up on the eve of a change in political priorities in environmental problems both at national and international level. In the last few years, the institute received more financial support from abroad than the IBDF ever had in order to carry out specific projects and to strengthen its organization for performing its supervisory role. Nevertheless, the IBAMA too, has been hindered in its functioning as a consequence of the lack of public funds for adequate staffing and equipment. 'The IBAMA has a staff of 1,300 in Brasília, yet only around twelve in the whole of Amazonia' lamented the former head of the Environment Secretariat, José Lutzenberger (quoted in the Financial Times, July 2, 1990). Moreover, serious accusations about corruption and the misuse of foreign funds earmarked for the protection of the rain forest still are heard (Brazil Report,

21. A good idea for combating corruption was suggested by Binswanger (1989) who proposed letting forest guards keep 30% of the fines as an incentive to enforcing logging rules and to protect forest and biological reserves against encroachment.

April 1992).[22] Policy making and reorganizing the organization are severely hampered by frequent changes of director. Between April 1989 and August 1992 five directors headed the organization in succession.

In short, the institutional setting has been changed but the aforementioned problems with the IBDF seem to have remained identical.

5.3.3 In search of a forest policy for the Amazon

Since the publication of the 1965 Forest Code, it had been increasingly felt by both the public and the private sector that the Amazon needed legislation and a forest policy adapted to its specific conditions. The formulation of such a policy has been a slow and difficult process that has been hampered by conflicting economic and political interests.

The first attempt to formulate a specific forest policy for the Amazon was undertaken in 1979 by a special interdepartmental working group whose recommendations strongly resembled those of Pandolfo and Schmithüsen described in Chapter 2. Their key suggestions can be summarized as follows:

- Preservation of natural areas such as national parks, biological reserves and ecological stations with a total area covering 50 million ha.
- Determination of forest areas to be rationally managed for timber production, referred to as 'National Forests', with a total area of 50 million ha.
- Establishment of standards of land-use for other economic activities (Valverde, 1980:50).

These recommendations were taken up by the National Council for the Environment (CONAMA) in a bill proposed to the National Congress (*Projeto de lei nº 4,970*) in 1983.[23] The bill included a proposal for a forest policy for the Amazon which was strongly based on the final report of the 1979 interdepartmental working group.

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22. These accusations were made public in Washington by José Lutzenberger, former head of the Environment Secretariat and confirmed in a report by a former auditor of the IBAMA. The comments made abroad by Lutzenberger ultimately resulted in his dismissal in March, 1992.

23. The CONAMA was created in 1983 to advise the president in environmental affairs and to formulate directives for a national environmental policy (Kohlhepp, 1991).

Two years later, the IBDF submitted an altered version of the proposed text (*Substitutivo ao Projeto de Lei nº 4,970*).[24] According to the IBDF proposal, the objectives of a forest policy for the Amazon included (1) the preservation and conservation of ecosystems, (2) the socio-economic integration of the Amazon region, (3) the protection of indigenous populations and their patrimony, and (4) the national security.

One of the actions proposed in order to realize these objectives was the design and implementation of an agro-ecological land-use plan (*Zoneamento Ecológico-Econômico*). Agro-ecological zoning was to regulate the spatial occupation of the Amazon region by specifying which areas were most suitable for different land uses such as small-scale farming, mining, hydroelectric plants and forest exploitation. The land-use plan would include the allocation and extension of areas for the preservation of ecosystems. It would also indicate which areas should be demarcated as indigenous reserves and which areas should be reserved for the military to maintain national security. Other proposals for the realization of the objectives included the intensification of research on flora and fauna, the regeneration of degraded areas and environmental education in primary and high schools.

As in the final report of the Interdepartmental Working Group of 1979, the IBDF proposed the demarcation of National, State and Municipal Forests with a total area of 50 million ha to be managed by national enterprises for the sustainable production of timber. The IBDF also proposed in the altered bill that the concession of financial and fiscal incentives to timber companies should be restricted to those enterprises which utilized timber from governmental forests, which exploited their own forests under a sound management plan or which utilized timber from governmental projects which aimed at transforming the forests into other land uses. The forests which were to provide integrated wood-processing industries with logs were to be located in areas defined in the agro-ecological land-use plan.

As to hydrological projects the IBDF proposed to make it obligatory that the timber in the area to be flooded be utilized prior to the construction of the dam. In addition, every public or private project which had potential

24. This duplication of effort was probably not so much the result of a striving for perfection as of a competitive struggle between the IBDF and the CONAMA with respect to the formulation of a forest policy.

harmful effects on the environment or on people (such as road construction, hydrological plants, mining projects and industrial complexes should be preceded by an environmental impact study and a study of possible alternatives as the CONAMA had proposed earlier.[25]

Finally, the IBDF proposed that the Brazilian government provide for an appropriate organizational structure of the institute, with adequate technical, administrative and financial support to co-ordinate, supervise and execute a forest policy (IBDF, 1987).

Some aspects of this proposal were also found in the Programme for the Defence of the Complex of Ecosystems of the Legal Amazon initiated in October 1988 and officially launched by president Sarney in April 1989. This programme, called in short 'Our Nature' (*Nossa Natureza*), was the first package of environmental measures with special reference to the Amazon region. It aimed at the establishment of conditions for the utilization and conservation of the environment and the renewable resources of the Amazon.

More specifically, the Our Nature programme intended to (1) reduce predatory action on the environment and on renewable natural resources, (2) structure the environmental protection system, (3) promote environmental education and public awareness, (4) control the occupation and exploitation of Amazonia through comprehensive land-use planning, (5) regenerate ecosystems affected by human action and (6) protect communities of indigenous people and the population engaged in extractive activities.

The programme dealt with some of the most serious ecological problems of the Amazon region. It suspended all fiscal incentives for cattle-raising projects in areas covered with tropical forest for 90 days. Mining companies were required to present a plan for the regeneration of the degraded area together with an Environmental Impact Report. The production, import and commercialization of mercury was made the subject of control and registration. Specific measures were designed to prevent and to combat forest fires.

A new institution, the Superior Environment Council (CSMA), was created to advise the president in the forming of a national policy and

25. The results of the environmental impact study were to be summarized in a report, the *Relatório de Impacto Ambiental* (RIMA), to be evaluated by the CONAMA. In practice, the RIMAs are seen as mere bureaucratic formalities which affect investment decisions hardly at all (Fearnside, 1988).

governmental directives with respect to the environment and natural resources. Members of the CSMA included representatives of all ministries and of non-governmental environmental organizations. Its principal task was to commission studies on possible environmental effects and alternatives to public and private projects whenever it deems them necessary. The CONAMA remained responsible for the appraisal of Environmental Impact Studies and the reports associated with them.

The following decrees and laws were issued with respect to the timber industry and other wood consuming enterprises:

1. Enterprises which utilize more than 12,000 m3 of roundwood per year are obliged to maintain or to create their own forest areas for the supply of raw material.[26] The minimum required percentage of roundwood from planted or managed natural forest is initially 40%, increasing to 100% by the year 1995.
2. Forest restoration can be realized through the implementation of reforestation projects, sustained-yield forest management or through the participation in forest development programmes approved by the IBAMA.[27] For wood-processing industries utilizing less than 12,000 m^3 roundwood per year it is still possible to pay the equivalent value of reforestation costs to the IBAMA on the basis of six seedlings per m^3 consumed. The IBAMA should invest this money in reforestation projects, forestry research and development or in the acquisition of forest land for the creation of National Forests (*Portaria 441/89* of August 1989).
3. It is no longer permitted to export logs and sawnwood thicker than 76 mm.

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26. This rule also refers to enterprises which annually utilize 12,000 steres or more fuelwood or 4,000 cubic metres of charcoal per year (decree 97,628 of April 1989).

27. The possibility of participating in forest development programmes was created by Regulation 710/90 of September 1989 and further elaborated in January 1990 by *Ordem de Serviço 005/90*). Through these regulations, commercial wood consumers could form an association for the execution of a reforestation project. These associations are required to register as such with the IBAMA, to design a reforestation project and to conclude an agreement with the holder of a rural property who participates in implementing the project for a period of at least five years. The reforestation association is responsible for the supply of saplings, fertilizer, insecticides and pesticides, as well as for technical assistance. The participating landholder provides the labour and takes care of the necessary operations and the protection of the planted trees.

4. It is prohibited to exploit the strip of forest along river banks of a width ranging from between 30-500 m dependent on the width of that river.[28]
5. Firms which sell chain-saws and those who buy them are obliged to register with the IBAMA.
6. The National Forests of Téfé in the state of Amazonas and of Amapá in the state Amapá are to be created for the sustainable exploitation of forest products (IBAMA, 1989).

'Our Nature' was more of an answer to the growing stream of criticism abroad and the threat of suspending multilateral loans than an real effort to implement a sound and comprehensive environmental policy (Tonen, 1989). The programme was announced on the eve of the president's trip to Europe where several Brazilian embassies had been confronted with protests against alarming rates of deforestation and worsening conditions for indigenous people. Funds to implement the programme were scarce. Moreover, the programme was launched in a political climate characterized by strong resentment against foreign criticism in the environmental field. Any suggestion from abroad was easily interpreted as being 'external interference in domestic affairs', 'loss of sovereignty' and 'internationalization of the Amazon'. Various politicians frequently stated that their priority lay in the unrestrained development and incorporation of the Amazon region.

The political climate around environmental problems and the internal and external pressures to deal with them, seemed - at least at federal level - to have changed with the accession of the new president Fernando Collor de Mello in 1990. Environmental issues became an important item on the political agenda. Collor's first action in the environmental field was the creation of a special Environment Secretariat (SEMA), with the power of a ministry. For two years it was headed by the internationally renowned scientist and environmentalist José Lutzenberger. The SEMA was made

28. The width of the strip along watercourses where forest exploitation is forbidden has been subject to several alterations in the law since the publication of the Forest Code in 1965. Originally established at a maximum of 100 m, a decree issued in 1986 regulated that forest exploitation was not allowed in a belt equal in width than that of the river. The maximum of 100 m was re-established in 1987, because of the impracticability of the decree in a region where rivers can be several kilometres wide.

responsible for all aspects of environmental policy and was given control over the IBAMA. The CONAMA was maintained as an advisory organ.

Non-governmental organizations gained in political power and were given a more structural place in the political arena. Hélio Setti - the director of an environmentalist organization lobbying for the preservation of the Atlantic forest - was invited by Collor to draw up an action plan for the environment for the first 10, 100 and 1000 days of the government. All the recommendations for the first ten and hundred days have been implemented. These recommendations included the creation of the SEMA, the definitive dismantling of the fiscal incentive programme for the Amazon and a complete ban on the export of hardwood logs (Cleary, 1991).

In June 1990, the Collor administration announced its 'Operação Amazônica' to combat the deforestation in Amazonia by the joint action of the IBAMA, the federal police and the armed forces. The plan included environmental awareness campaigns in the states with highest deforestation rates (Pará, Rondônia and Mato Grosso); the deployment of civil and army pilots to discover illegal logging operations and forest fires in remote areas; the use of satellite images to detect and combat forest fires and the dynamiting of illegal airstrips in the Yanomani area in the state of Roraima to force all the gold miners out of the area.

In 1990, the campaign had resulted in the confiscation of 20,000 illegally cut logs and a total amount of US$ 9 million in fines to 3,500 who had violated the cutting and burning regulations (New York Times, March 26, 1991).[29] Deforestation rates show a tendency to decline with a drop in the area of annual clearings from 18,619 km^2 in 1989 to 13,655 km^2 in 1990 and 10,972 km^2 in 1991 (New York Times, June 26, 1991; Washington Post, March 28, 1992). Whereas the government attributes the slowing rates of deforestation to its environmental measures, critics ascribe it to the heavy rains and the severe economic recession of the recent years. Although some actions were certainly spectacular, there is still a lack of financial means and personnel for the structural implementation of environmental measures (Kohlhepp, 1991). Whatever the facts may be, the Collor government has succeeded in focusing attention on some of the major ecological crimes in the region.

29. An officer of the IBAMA declared to the Miami Herald (September 22, 1991) that hardly 20% of the fines are ever paid.

Another remarkable change of attitude of the Collor government in comparison with its predecessors, is its openness to international co-operation. Even debt-for-nature exchanges, which, under president Sarney provoked strong nationalistic sentiments ('not one centimetre of Amazonia will be turned over to foreigners') are now under discussion.[30]

The apparent change in Brazil's ecological policy and its new open-mindedness towards international cooperation in this field, induced the Group of Seven major industrialized countries (G-7) to request the launch of a proposal for a pilot programme for the conservation and management of the Amazonian rain forest. The plan, which was drafted by the World Bank, the EC Commission and the Brazilian government, was presented at the Economic Summit in London in July 1991. It proposed a budget of US$ 1.2 billion over a five-year period for measures ranging from environmental awareness programmes to the creation of National Parks and Biological Reserves and the demarcation of indigenous areas. Other aspects of the plan include the management of natural resources, the rehabilitation of degraded areas, the strengthening of institutions and projects of a more scientific and technical nature (de Groot et al., 1991).

By the end of 1991, a budget of US$ 50 million was approved to initiate the project; significantly less than the US$ 250 million which Brazil was expecting. Doubts were raised about the bureaucratic nature of the institutional framework and about the structural character of the policy changes in the environmental field. Further negotiations on the funding of the programme have been proceeding slowly since. Within Brazil, the programme has been criticized as being another effort by foreigners to dictate rain forest politics on behalf of their own non-environmental interests (Brazil Report, September 15, 1991; Financial Times, December 1991).

In conclusion, we can say that efforts to formulate a coherent forest policy for the Amazon region have been part of a very laborious process,

30. Debt-for-nature swaps constitute a strategy to link foreign debt adjustment to environmental projects. The basic idea behind them is that an environmental organization or another third party acquire a commercial bank debt by donation or through the purchase of loans on the secondary market and cancel it in return for the provision by the borrower country of local currency to be invested in conservation projects (Bramble, 1987). The principle has already been put into practice in Bolivia, Costa Rica and Mexico.

underway now for more than twenty years. In spite of increased political concern about environmental issues, the institutional framework constitutes serious constraints for sustainable forest management. The legislation and the institutions engaged in the formulation and implementation of the laws are constantly changing. This not only creates uncertainties for the various institutions with respect to their respective competencies but also for the people and the enterprises involved in the exploitation of forest products. The transformation of the IBDF into the IBAMA did not result in a strong forest service capable of effective control and of encouraging sustainable forest management. Comprehensive land-use planning for the Amazon region which allocates space to sustainable forest management, other economic activities and preservation, is still absent in spite of the political intentions and initial efforts of the past.

5.4 The prospects for sustainable forest management in Brazilian Amazonia

In addition to the institutional framework, several other elements are considered as being essential to successful forest management. These key factors will be presented below and compared with the situation in Brazilian Amazonia. Finally, we will try to assess the prospects for sustainable forest management in the Amazon and the application of ecologically sound logging methods on a commercial scale.

On the basis of the work of Poore (1989), Buschbacher (1990) and Jonsson & Lindgren (1990) the following conditions for successful sustainable forest management can be identified:

1. *A comprehensive land-use policy* by which land is allocated to both forestry and agriculture and other economic activities in accordance with the prevailing physical and socio-economic conditions. The traditional land rights of indigenous people are thereby to be taken into account. Only within the context of an overall land-use planning, can forests be reserved for specific purposes and be protected as such.
2. *Adequate information* on the forest resource, competing claims on the forest land and the potential market in order to select the appropriate location of the forest estate. For adequate forest management information is also required about the prospects of regeneration and growth rates. Existing information about on sustained-yield management needs to be disseminated more and also be put into practice.

3. *Long-term security of tenure* in order to encourage investments in sustainable management systems with returns in the remote future.
4. *The ability to control logging operations* in order to prevent unnecessary ecological damage and over-exploitation. This implies the establishment of annual allowable cuts, felling cycles, tree marking, harvesting techniques and the adequate control of harvesting and subsequent operations.
5. *A secure and stable market for the production* of managed forests at prices that compensate for the investment in forest management. In general, economic incentives are needed to prevent the conversion of forest to land-uses which are more lucrative in the short term.
6. *The involvement of local people* in management decisions and project benefits. People are more willing to protect a resource if they benefit from it themselves.
7. *The political will* and an active role played by the government in managing forests in a sustainable manner.

If these conditions are compared with the actual situation in the Brazilian Amazon, it becomes clear that there are few causes for optimism with respect to the prospects for sustainable forest management in this region. With respect to land-use planning, some advances in agro-ecological zoning have been made during the past few years.[31] In both Rondônia and Pará, several land-use zones have been identified on the basis of data on geology, geomorphology, hydrology, soils, vegetation and fauna in these states. The zoning should provide a basis for regional development planning and for the allocation of areas for the preservation of ecosystems, indigenous areas, the exploitation of non-timber products, sustainable production of timber, farming, ranching, hydroelectric development and mining (Cleary, 1991; Dias et al., 1991 and da Costa et al., 1992).

The problem with these efforts is that they have all come too late. The situation as it has developed during the past decades has resulted in a settlement pattern that cannot easily be dismantled. The areas opened up in the past are no longer empty spaces to be filled in in theory from behind an office desk. Rigorous measures are required to solve land conflicts and

31. Cleary (1991) points to the fact that this progress had been made possible by advances in satellite imaginary and computerized Geographical Information Systems (GIS).

to protect indigenous areas. Successful land-use planning requires the close co-operation of all the groups affected (Cleary, 1991).

The security of land tenure is another condition that is rarely fulfilled in the Brazilian Amazon. Land conflicts are numerous and the large properties which are needed for forest management are rarely free from other claims. Moreover, forest management is still considered to be an 'unproductive' land-use, which makes it subject by law to expropriation for the purpose of land reform (see also Chapter 6).

The fulfilment of the third condition - the ability to effectively control logging operations - is severely hampered by the IBAMA's lack of personnel, equipment and financial means as we have seen earlier in this chapter.

The economic conditions for forest management directed towards the sustainable production of timber are poor. Close to the colonization areas, where cheap logs are provided from clearings, there is no market for relatively expensive roundwood from sustainably managed forests nor can a company compete with others if it utilizes this roundwood. There is also the temptation to earn larger profits in the short term by land speculation and the conversion of forest to pasture. The profit margins of the majority of the sawmills do not allow for investments in forest management.[32] Only large sawmills and very large timber companies can afford these costs.

Information on sustainable forest management can be said that to be limited both among sawmill owners and the staff of the IBAMA. The results of pilot projects in the region are put on the shelves of the research institutions. Ongoing research suffers from constant cuts in funding.

The condition for successful forest management which refers to the active participation of the local population is far from being fulfilled in the Brazilian Amazon. On the contrary, local people are frequently involved in

32. Uhl et al. (1992) estimate the cost of forest management for sustainable timber production based on the CELOS management system at US$ 180 per hectare. This sum includes tree marking, climber cutting and silvicultural treatments after harvesting. Accepting a log to sawnwood conversion rate of 2:1 and a harvesting volume of 20 m^3/ha, the annual management costs for small sawmills which produce, on average, 195 m^3 per year, would absorb 91% of their gross profit (cf. Appendix 6). For medium-sized sawmills with an annual production of 1,042 m^3, forest management would absorb 32% of their gross profit. These percentages amount to 23% and 19%, respectively, for large and very large firms.

conflicts with timber companies because of the lack of benefits and the disadvantages they experience with current logging practices.

Finally, there is little evidence that the political will to support sustainable management practices has substantially changed. Though environmental issues have gained in importance at national level, little has been done to strengthen the IBAMA, to regulate land occupation or to promote sustainable development in Amazonia.

As a result of this situation, there are few companies with an operational management plan - even among those who possess their own forest area and undertake their own logging operations. Only nine (13%) of the surveyed sawmills had a management plan - at least on paper. Two others (3%) implemented reforestation projects which were monocultures.

Nine companies in our survey were obliged to execute a plan for sustainable forest management on the basis of their annual roundwood consumption of 10,000 m3 or more. Apart from the two companies with a reforestation project, two others had no such plan. Two companies had a management plan on paper. One of them had not yet implemented it and the other had not yet obtained any roundwood from the managed forest. The three remaining companies had obtained part of their raw material from a forest which they claimed to manage on a sustainable basis. In these cases, however, not more than 20 to 30% of their roundwood needs was supplied from these forests. The rest was bought from lumbermen or obtained through logging operations on land to be cleared for pasture. Their management plan was primarily meant to fulfil the legal requirements, but could not be considered to be a serious effort to obtain roundwood from sustainably managed forests.

In addition to the companies which had been obliged to undertake sustainable forest management by law, four other companies in our survey worked with a management plan. On the basis of the data about their roundwood consumption, the forest area under management and the share of their own logging operations in the total supply of logs, it was possible to calculate that, in principle, half or more of their roundwood supplies could have come from the managed forest.[33] We were not, however, able

33. We assumed an average felling cycle of 20 years and a mean production of 30 m^3 per hectare per felling cycle, in accordance with the CELOS management system described in Appendix 4. Thus, the amount of roundwood that could be obtained annually from the managed forest was calculated by dividing the total area of managed

to assess the quality of their management plans from a forestry point of view.

Seven of the nine companies with a management plan applied a system based on selective logging with silvicultural treatment and enrichment planting. For one company the management practice consisted of 'log and leave' and one company applied a management system based on natural regeneration (selective logging and liberation thinning).

For most sawmills the question of forest management or reforestation was irrelevant as they did not exploit the forest themselves (35%) or because they logged forests to be cleared for agriculture (25%). Eight sawmill owners (11%) had chosen the option to pay a forest share to the IBDF. Three sawmills (4%) had no management plan because of a lack of funds. Four sawmills (6%) considered these measures unnecessary for the Amazon region, as they assumed that the forest regenerates by itself when left to recover after logging. Two of the sawmills without a management plan (3%) intended to change over to sustainable practices in the near future.

To sum up, there is little perspective that prevailing logging methods will change in the near future. Both the general conditions and the current methods for providing the sawmills with logs are highly unfavourable for the successful implementation of forest management on a commercial scale.

5.5 Summary

The ecological aspects of uncontrolled mechanized logging make the timber industry a controversial one. We have seen that mechanical logging operations have resulted in considerable damage when compared with the actually harvested timber volume. To extract at most 3% of the trees per hectare, a quarter to half of the remaining trees are lost or are severely damaged. In addition, these operations affect the soil, wildlife, the diversity of tree species and genetic resources negatively and they increase the susceptibility of the forest to fires.

However, commercial logging is not among the major causes of deforestation in the Brazilian Amazon. The impact of cattle ranching, farming, road construction and large hydroelectric and mining projects is

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forest in hectares by 20 and multiplying the result by 30 m^3.

much more pronounced. A second aspect to be taken into account when assessing the ecological impact of logging in Amazonia is that much of the timber exploitation is associated with making clearings for ranching and farming. In those cases, the trees would have been felled in any event and commercial logging cannot be regarded as the primary cause of deforestation. Finally, the impact of the majority of the logging operations is not as strong as those of the aforementioned large-scale operations, as the use of heavy equipment is not yet widespread.

Forest management for the sustainable production of timber is technically feasible. Several management systems of varying intensity have been developed to achieve sustained yields while maintaining the essential ecological functions of the forest. It must be stressed, however, that forest management for the sustainable production of timber requires land-use planning which not only allocates forest land to timber exploitation but also to the exploitation of other forest products and to the preservation of ecosystems. Traditional land rights of indigenous people and claims for non-forest uses, such as farming, are to be taken into account. As the different social, economic and ecological functions of the forests are not always spatially compatible, management objectives for different tracts of forests need to be specified in order to define a suitable management strategy.

In the Brazilian Amazon, such a land-use policy so good as totally absent. Conservation areas, indigenous reserves and national forests to be managed for the sustainable production of timber exist, but are not effectively protected from encroachment by settlers, gold miners and loggers. Forest management for the sustainable production of timber is confined to a few pilot projects carried out by several governmental institutions. We described three examples of projects located in our study area: the management plan for the Tapajós National Forest, research on natural forest management at the experimental station of Curua Una and trials on the regeneration of degraded areas and secondary forests at Belterra. These examples showed that management systems based on light selective logging and natural regeneration offer better prospects for the Amazon than do intensive systems based on enrichment planting. Replanting of homogeneous forests on degraded areas is not considered viable because of their high degree of susceptibility to pests and diseases.

The main impediments to sustainable forest management are not technical but socio-economic and political. Successful implementation of

forest management requires a strong forest policy and a strong forestry service. The Brazilian Forest Code and more specific regulations on forest exploitation and conservation are usually violated as the result of understaffing and lack of funds and equipment of the IBAMA forestry service. The formulation of a forest policy for the Amazon is a slow and difficult process. The need to regulate the occupation of the region and to protect the rain forest is being felt increasingly. But the policy measures launched in the past few years seem to be more of a reaction to foreign pressure than an expression of an intrinsic political will to implement a comprehensive land-use policy aimed at the sustainable development of Amazonia.

The prospects for successful forest management in the Brazilian Amazon are poor in other respects, too. A review of essential conditions showed that few, if any, of these conditions are being fulfilled. Only a small minority of timber companies obtain logs from forests managed on a sustainable basis. Most of the scarce management plans exist mainly on paper or on a scale that is just enough to meet legal requirements. The real intention to change over to ecologically sound logging practices is not present. The main reasons can be found in the method prevailing of being provided with roundwood by lumbermen and/or from forests to be cleared for agriculture. Within this context, we cannot expect that sustainable exploitation methods will be applied on a commercial scale in the near future.

6 The social and economic dimensions of the Amazonian timber industry

In this chapter we will consider the social and economic aspects of the timber industry in the Brazilian Amazon. We will do this on the basis of the questions which emanated from our definition of development presented in Chapter 1. The first question to be dealt with is the role of the timber industry in our study area, and in other parts of the Brazilian Amazon, in the satisfying of local basic needs. Then we will consider what role the timber industry plays in disparities in income and access to land and other resources. We will look first at the timber industry as a source of income, analysing the employment created and the labour conditions, links with the colonization process and the destination of profits earned in the timber industry. Next, we will focus on conflicting land and forest uses. The final aspect to be analysed in this chapter is the involvement of local people in the development of timber-based industries.

6.1 Timber exploitation and the satisfaction of local needs

One of the reasons that the timber industry is often presumed to contribute little to the welfare of local people is its orientation towards distant consumers. The most valuable wood species are sold in markets where the highest prices are paid and these are generally not to be found near local areas of exploitation. Representatives of various social organizations feel that the population in the region either very little or not at all benefits from the increases in timber production. Quite the reverse, it is felt that the amount of quality timber available for the local market has decreased with the expansion of the region's timber industry and that prices for prime hardwood have risen to unaffordable heights. For local buyers with low incomes, only inferior woods are available.[1] This point corresponds to our observation in Chapter 3, that consumers are more selective in their choice of timber species as the distance to the extraction areas increases. With increased demand for quality timber, it gains in value beyond the price level

1. This aspect was spontaneously mentioned in interviews with representatives of the trade union of workers in wood-processing industries, the trade union of rural workers and a local environmental organization.

that local consumers can afford. Only lesser known species and low-grade timber with no outlet in other regions can be sold at reasonable prices to local consumers.

As we will show in more detail in the next chapter, the major part of the production of the sawmills and timber companies in our survey is marketed outside the Amazon region. Less than 10% of their total production is sold in local markets; 48% is marketed in other regions of Brazil and 43% is exported. The orientation towards the national market - outside Amazonia - is somewhat stronger for the large companies in Belém than it is for the large companies located in Santarém and its environs. Whereas the surveyed enterprises from Belém sell 56% of their production in non-Amazonian regions within Brazil and market 40% abroad, these percentages amount to 27% and 66%, respectively, for the largest sawmills in our study area. The available infrastructure and the condition of the roads connecting the two cities with southern and southeastern markets is probably the main explanatory factor for this difference. The Belém-Brasília highway is much better than the road from Santarém to Cuiabá. But, whereas Santarém is not easily accessible to trucks, it is to sea vessels, thanks to the city's good port facilities.

With respect to the orientation towards external markets, it is important to distinguish between the small sawmills - with a production up to 500 m^3 a year - on the one hand, and medium and large sawmills on the other. The small ones market 87% of their production locally whereas this percentage amounts to 37% and 7% for the enterprises operating on a medium and large scale, respectively. Although the 41 small sawmills constitute 70% of all production units in the timber industry in our study area, their production is only 16% of the region's total output of sawnwood and other timber products. Hence, it must be concluded that the majority of the sawmills in our study area are primarily producing timber for local use in construction, boat-building and agriculture. Nevertheless, their production when compared with that of the medium-sized and large sawmills is so small that most of the region's timber production is sold on external markets.

Apart from its orientation towards external markets, the timber industry can also interfere with the satisfying of basic needs when it frustrates local forest uses, such as hunting, gathering, shifting cultivation and logging for local needs.

> The people used to live on the game, the fish, the timber, the *breu*[2], the Brazil-nut and the latex from the *maçaranduba*. It has virtually all disappeared with the removal of the trees by the timber companies (community leader in the interior of Santarém, 1989).

Several interviews with community leaders and representatives of social organizations have revealed that animals which were hunted for food have disappeared after forest exploitation by timber companies. Not only do the animals temporarily flee from the noise that accompanies logging activities, they may also become extinct locally as the result of the loss of their food sources when they are fruit eaters of trees which are over-exploited. Maçaranduba (*Manilkara huberi*), for example, one of the most exploited species in our study area, bears a fruit, consumed by parrots, monkeys, turtles, agouti (*cutia*) and deer (*veado*) (Uhl & Vieira, 1989). The latter two are regularly hunted in our study area to meet the local need for meat. Another example of a tree whose fruit is consumed by both humans and game is piquiá (*Caryocar villosum*) (Natanael, personal comment, 1989). These trees play an important role in hunting as hunters wait there at night until the game appears. If these trees disappear in the neighbourhood of the inland communities as the result of over-exploitation, hunting - and with it the supply of protein - is severely restricted.[3]

6.2 Timber exploitation as a source of income

6.2.1 Employment opportunities: quantitative aspects

The Amazonian timber industry is an important source of industrial employment. In the states of Pará and Rondônia, where 90.5% of all Brazilian roundwood was produced in 1989 (IBGE, 1991), the timber industry was providing a total of 13,606 jobs at the end of 1980 (IBGE, 1983). This number corresponded with 34% of total industrial employment

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2. *Trattinickia burserifolia.*

3. This means that protein supplies for the communities along the Tapajós river are being jeopardized in two ways: the people fear eating fish because of pollution with mercury from the gold-mines and they are hindered in hunting as the result of the local extinction of trees which previously provided food for game.

in these states. Sawmills accounted for 79% of all employment in wood-processing industries and 94% of the workers were male (Table 6.1).

Table 6.1 Industrial employment and the timber industry in Rondônia and Pará (1980)

Sector	Men	Women	Total
Total industrial employment	61,422	11,227	72,649
Timber industry	23,607	1,409	25,016
Sawmills	?	?	19,710

Source: IBGE, Censo Industrial 1980.

According to data from the 1980 industrial census, the timber industry in the municipality of Santarém provided 502 jobs in 1980, the equivalent of 25% of all local industrial employment (Table 6.2). Together with the textile and food industry, it was one of the principal sources of industrial employment in the area. The contribution of the timber industry to total employment in the region was low when expressed in terms of the total active labour force (1.3%) since only 7.5% of the region's labour force was engaged in industrial activities (Table 6.3).

According to our survey, during the dry season of 1989, the 60 sawmills in the Santarém region employed 1,092 labourers of which 72 (7%) were women. Of the total number employed, 218 people (20%) were engaged in extraction, 727 (67%) in production and the remaining 147 (13%) in auxiliary functions such as administration, transport, maintenance and guarding.[4] Whereas the extraction and sawing of logs are exclusively 'male' activities, the further processing of sawnwood, the production of veneer and the packing of lighter timber products also creates opportunities for female employment. Of the 72 women employees, 41 (57%) worked in wood processing, 20 (28%) in clerical work and 11 (15%) in other jobs such as cleaning and cooking.

The number of workers per sawmill is related to the volume of its production only to a certain extent. Table 6.4 shows that 83% of the small sawmills employed less than 10 workers and 69% of the medium sawmills employed between 10 and 49 workers, averaging 29 employees per sawmill.

4. A description of the functions and the characteristics of the workers who were interviewed is presented in Appendix 6.

Aside from the volume of production it is also the degree of processing that influences the number of workers employed. When, in addition to the production of rough sawnwood a sawmill is also engaged in the elementary

Table 6.2 Industrial establishments and employment in Santarém (1980)

Sector	Establishments Abs.	%	Employment Abs.	%
Transformation of non-metallic mineral products	16	9%	107	6%
Metals	17	9%	68	4%
Transportation material	8	4%	75	4%
Timber	31	17%	502	25%
Furniture	39	21%	121	6%
Textile	6	3%	480	24%
Foods	56	30%	414	21%
Publishing and printing	4	2%	46	2%
Others	10	5%	164	8%
Total	187	100%	1,977	100%

Source: IBGE, Censo industrial 1980.

Table 6.3 Active labour force in the municipality of Santarém (1980)

Sector	Abs.	%
Agriculture, extractive activities and fishery	23,420	43.9%
Transformation industry	3,998	7.5%
Construction	2,421	4.5%
Other industrial activities (incl. mining)	2,100	4.0%
Commerce	5,861	11.0%
Transport and communication	2,389	4.5%
Services	6,429	12.1%
Social activities	2,899	5.4%
Public administration	2,186	4.1%
Other activities	538	1.0%
Looking for work	1,081	2.0%
Total	53,322	100.0%

Source: IBGE, Censo demográfico 1980.

manufacture of timber products ready for local use in flooring, roofing and joinery, labour needs may increase substantially. Demand for wage labour by small sawmills in the colonization areas may be limited accordingly as more family labour is available. Other explanations for the divergent employment levels between sawmills with similar output volumes are the workability of the tree species that are used, the quality of the sawmill's equipment and the efficiency with which the production process is organized (Bruce, 1976).

Table 6.4 Number of employees according to production class

	Size and location of sawmill					
	Small	Medium	Large	Total study area	Large Belém	Total survey
	Study area					
Number of employees	(n=41)	(n=13)	(n=5)	(n=59)	(n=11)	(n=70)
<10	83%	23%	-	63%	-	53%
10-24	15%	31%	20%	19%	-	16%
25-49	2%	38%	-	10%	-	9%
50-74	-	8%	20%	3%	27%	7%
75-99	-	-	-	-	9%	1%
100-149	-	-	40%	3%	-	3%
150-249	-	-	20%	2%	18%	4%
>250	-	-	-	-	46%	7%
Total	100%	100%	100%	100%	100%	100%
Total number of employees	212	337	543	1,092	3,824	4,916
Average	5	26	109	19	348	70

Source: Author's field research, 1989.

The widest variation in employment levels was found among the large enterprises with differences ranging from as much as 57 to over 1,000. The larger sawmills in Santarém, on average, employed less workers than did the companies in Belém, 109 as against 348. The latter not only produced a larger volume but more of them were also engaged in the labour-intensive production of veneer, plywood and other more sophisticated products. Accordingly, the number of women employed in these enterprises was also significantly higher. The eleven companies in Belém employed together

3,131 men and 693 women. Most of these women (81%) were engaged in the production of veneer, plywood and, to a lesser extent, parquet.

The volume of employment in the timber industry is also subject to seasonal variations. In regions where upland forests are exploited, wood can only be extracted during the dry season as heavy rains make roads impassable and hinder access to the forests.[5] In the rainy season roundwood supplied by third parties drops to virtually zero. Production levels can only be maintained by sawmills with sufficient capital to build up stocks of roundwood. As a result, forest workers are dismissed and the number of workers engaged in production is reduced. In our study area, total direct employment amounted to 841 during the rainy season of 1989; a reduction of 23% relative to the employment of 1,092 people in the dry season.

The decrease in employment is smallest for large sawmills. Because of their stocks of roundwood, their production level shows little variation throughout the year. Accordingly, the number of workers employed in the rainy season does not substantially differ from the number employed in the dry season. The decline in employment level amounted to 3% for the large companies in Belém and 7% for the largest sawmills in the Santarém region. Only a proportion of the forest workers were dismissed and alternative employment was available at the sawmill for others.

The situation is different for workers in small and medium sawmills which are not able to stock up with logs for the rainy season. During the rainy season production by these sawmills decreases by two thirds compared with its level in the dry season. In 1989, more than half of the small sawmills and nearly one third of the medium sawmills had to close down for periods ranging from one to seven months due to the lack of raw materials. As a result, total direct employment provided by small and medium sawmills during the rainy season of 1989 was 38% lower than during the 'summer' months (338 versus 549).[6]

Although production decreases are similar, the decline in employment is more marked for medium-sized sawmills (44%) than for small ones (27%). A comparison of the composition of the dismissed workers in both

5. In regions where logs are transported by water, roundwood supplies decline during the dry season.

6. The dry and the rainy season are locally referred to as 'summer' and 'winter' respectively.

categories shows that this can be explained by the stricter division of labour in the medium-sized sawmills. In small sawmills only 10% of the seasonal workers are forest workers, whereas this percentage amounts to 52% of the seasonally employed labourers in medium-sized sawmills. Workers in small sawmills are often engaged in both logging and production. Even when extraction stops, there is work for them as long as logs are available and production carries on. On the other hand, medium sawmills employ more workers who are exclusively engaged in extraction. These workers are dismissed at the beginning of the rainy season. Because of lower production levels not only is alternative employment in the sawmills unavailable, the number of production workers has to be reduced, too.

In addition to the labour force employed directly, the region's timber industry created indirect employment through its backward linkages with roundwood suppliers for approximately 250 people. In Chapter 4 we mentioned that 60-70 autonomous lumbermen are active in the region, each employing an average of three helpers.

Other backward linkage effects on employment were limited. Inputs such as new machines and their spare parts were virtually exclusively obtained outside the Amazon, mainly from the southern states (São Paulo, Paraná, Santa Catarina, Rio Grande do Sul) and, to a lesser extent, from abroad. Only some small mills with simple equipment obtain spare parts from local metal-turners and hardware shops. These shops also provide articles for the daily maintenance of the machines, such as grease, files and screws. Other inputs acquired locally are gasoline, lubricating and diesel oils. Although some employment is generated through the demand for these products, no data are available in order to assess its volume.

Employment created through the industry's forward linkages is also limited. As will be seen in the next chapter, only 15% of total timber production in 1989 was sold locally for use in construction or for further processing in carpentry or furniture making. According to the 1980 industrial census for Pará as a whole, carpentry, joinery and the manufacture of pre-fabricated houses together added 6.4% to the employment created by sawmills and other primary wood-processing industries. In the same year, furniture production accounted for 6% of total industrial employment in Santarém (Table 6.3). Assuming that the 1,092 jobs in the timber industry in 1989 still represented 25% of total industrial employment, we can extrapolate from these data that indirect employment

through forward linkages amounted to approximately 330 jobs in 1989, when construction is excluded.[7]

In addition, some jobs were created through the utilization of residues for charcoal production. The practice was not widespread; the residues of only ten of the surveyed sawmills (14%) were utilized in this way. In most of these cases, principally in the colonization areas, the product was meant for domestic use by the sawmill-owner's family or one of his neighbours. In the city of Santarém, however, two sawmill owners reported that residues were sold to families who sold their production to local consumers. Altogether, some 30-50 families were involved in this trade.

Taking all these backward and forward linkage effects into account, total employment related to the timber industry in our study area amounted to upwards of a 1,700 jobs in the summer of 1989.

6.2.2 Qualitative aspects of created employment

Not only the quantitative aspects of employment but also some qualitative ones are relevant for the assessment of the socio-economic performance of the timber industry. These aspects are the methods for recruiting labourers and their influence on migration patterns, working conditions (in particular safety of work and remuneration) and labour conflicts. In this section we will also study labour problems as seen from the employers' point of view.

In our study area sufficient labour is available to recruit locally. For unskilled labour the sawmill does not even need to undertake any action as workers looking for a job appear at the mill gate every day. If the mill needs any additional labour it is generally sufficient to mention this to the people already employed and/or to place a billboard in front of the establishment announcing the vacancies. Occasionally announcements are made on the radio. Advertising in newspapers is only practised by the large

7. When construction is included, the timber industry's multiplicative effect on employment has been much stronger. If the different sectors bore the same proportion to each other with respect to employment in 1989 as they did in 1980 (Tables 6.2 and 6.4), we can compute the number of people engaged in construction in 1989 at 2,620. However, it is highly dubious to attribute this number to the timber industry. In the city, where brick houses predominate, construction is only partly related to the timber industry.

companies in Belém. Only a few sawmills associated with a *fazenda* made use of subcontractors (*empreiteiros*) for work in the extraction phase.[8]

When skilled labour such as band-sawyers and grinders, is needed some difficulties may arise, particularly in the interior and during the dry season. Though these categories of workers are also mainly recruited through spontaneous applications for work and through contacts via employees, the need to call upon other forms of recruitment arises more frequently. In these instances, the services offered by the government's industrial employment office (SINE) can be of help. Larger firms sometimes resort to the practice of buying skilled workers away from other mills. They offer a higher salary in order to persuade them to change their employer. Large companies in Belém more frequently make use of billboards and advertising in newspapers to recruit skilled labour.

Interviews with workers showed that the principal way to find a job in this sector (58% of all respondents) was through contacts with relatives or friends already working in the timber industry. Of secondary importance was directly applying for work at the mill gate (20%). Six workers (10%) were invited by the owner to work at the sawmill. Two workers (3%) applied for work after an announcement had been made on the radio.

In the Santarém region, the recruitment of labour outside the place where the sawmill is located occurs only to a limited extent. It is virtually restricted to the sawmills in the colonization areas which often need to attract workers from neighbouring villages. As most of these sawmills employ few workers and the distances involved are short, this does not affect intra-regional migration patterns. Employees recruited in other regions of Brazil are found virtually exclusively at management level in the larger sawmills.

The low significance of distant labour sources is also reflected in the results of the interviews with 60 workers in the timber industry of

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8. Subcontracting through *empreiteiros* is more common on large estates, especially for jobs with a temporary nature such as clearing or harvesting. In regions with labour shortages *empreiteiros* recruit unemployed workers in the older urban centres or in the pioneer towns. Prior to the influx of spontaneous migrants workers were even recruited in the Northeast. This being the case, migration patterns both from outside and within the region, can be seriously affected. A notorious example is the migration of northeasterners who were recruited as rubber tappers at the end of the 19th century (Santos, 1980). For more details on the recruitment methods in cattle ranching see Poelhekke (1984).

Santarém. Only five of the 36 workers who migrated to the city did so because of the employment opportunities in the timber industry.[9]

This situation is sometimes quite different in recently opened up areas where sawmills may need to recruit labour from neighbouring population centres. In those instances, the sawmill generally provides housing for its employees. New towns may originate out of these situations when public services are subsequently requested and other commercial activities develop around the new nucleus. This contribution of the timber industry to urban development in colonization areas will be highlighted in more detail in Section 6.2.3.

With respect to working conditions in the timber industry, the interviews with workers show that 38% of the respondents were more or less content with their work. In many cases this satisfaction does not refer to concrete labour conditions but to their relationship with the employer. When workers like their boss and feel that they will be helped in the case of illness or other private problems, they consider themselves fortunate in their job, even when their salary is low. For some workers the right to free health care at the National Institute of Social Welfare (INPS) as a result of being formally employed was an explicit reason for contentment. Two workers were satisfied because they received a good salary.

The main reasons for discontent are the high risk of labour accidents (expressed by 28% of the respondents), low wages (22%) and the heavy workload (18%).

The high incidence of accidents at work is a serious problem. Gueiros et al. (1989) analysed a total of 534 accidents reported to the INPS in Santarém during the year 1987. The authors consider the study to be representative for the total population of enterprises and labourers, although

9. Of the 36 workers who migrated to the city 27 (75%) originate from the rural interior of the region, three (8%) came from other Amazonian cities and six workers (17% of the migrants) previously lived elsewhere in Brazil. More than half of the migrants (53%) had in Santarém lived for more than ten years and five (14%) had done so for a period of between five and ten years. Five workers (14% of the migrants) migrated less than a year ago, another five (14%) between one and three years ago and two workers (5%) had lived in Santarém for three to five years. The principal motives for migration were lack of prospects in the region of origin (22%), the educational facilities in the city (19%), employment opportunities in general (14%) and employment opportunities in the timber industry (14%).

the actual number of accidents was much higher.[10] Not every accident is reported to the authorities and only formally employed labourers can appeal to the services of the INPS. The principal result of their study is that the timber industry (29% of all cases), together with the building trade (18%) and the textile industry (10%), induce most labour accidents.[11] Our own inventory of accidents at work registered at the INPS between 1979 and 1989 reveals that the share of the timber industry in the total number of accidents ranged from 16% to 39%, with an average of 27% during this ten-year period.

Gueiros et al. also found that 71% of these accidents occurred during the first four hours of the working day, with a peak during the first two hours (40%). They suggest - on the basis of other studies - that this indicates a relationship with deficient nutrition at breakfast and an inadequate night's rest. In addition to insufficient nourishment, they attribute the high number of labour accidents in the timber industry to the high turnover of personnel, disregard of security norms and preventive measures and to alcoholism.

Data from our interviews with workers in the timber industry show that 77% of the workers feel that their work involves a high degree of risk. Thirty-six of them (60% of all interviewed workers) had actually suffered one or more accidents. The most frequent accidents cited were collisions (35%), injuries resulting in the loss of a part of finger or hand (16%), cuts in hand, arms or legs (14%) and jamming (12%).

A specific risk for chain-sawyers is the 'kick-back', which occurs when a chain-saw reacts as the result of the slipping of the chain over the bar (Costa & Costa Filho, 1983). The principal fear for workers in the sawmill is the rupture of the band-saw. When this happens and the blade is flung from the flywheel, it may cut any part of the body of those around and even result in their death. The use of obsolete equipment and materials enhances this kind of risk. A particular risk for grinders is to have their eyes injured by flying sparks from the emery wheel - something that

10. It is generally estimated that only one third of labour accidents are reported to the INPS.

11. The authors do not present data with respect to the relative weight of these sectors in the local economy. Tables 6.2 and 6.3 suggest that twice as many people are employed in the building trade and that the number of workers in the textile industry is approximately the same as that of the number employed in the timber industry.

happened to three of the eight grinders in our sample. In the long term, sawdust may injure the eyes and the lungs.

The workers attribute the causes of these accidents to their own carelessness and to lack of instructions and protective measures. Indeed, the sawmills do little or nothing to prevent accidents. In many sawmills even a first-aid box is absent. More than half (53%) of the workers interviewed had never been instructed about how accidents could be prevented. For another 27% the instruction had been limited to warnings to be careful. The remaining 20% had been instructed about how to handle the machine they worked with and had protective clothing at their disposal such as gloves, boots and a helmet.

A second aspect with regard to the labour conditions refers to wages. On average, the costs involved with wages and other expenses for labour amount to 23% of the total costs for sawmills in our survey. The relative share of labour costs is highest along the exit roads from Santarém (36%) and lowest for the sawmills along the Transamazônica (21%); a difference which can be explained by the larger share of family labour in the latter group. In the cities of Santarém and Belém the share of labour costs in total exploitation costs amounts to 29% and 30%, respectively.

In general, wages are low but not worse than in other industrial branches or in commerce. In October of 1989 the statutory minimum wage in Brazil amounted to US$ 85 per month for an average of 48 working hours per week. Data from interviews with workers and sawmill owners show a weighted average of US $ 128 per month for all workers in the timber industry. The lowest wages - US$ 97 per month on average - were paid to unskilled workers in the sawmill, such as helpers and packers. Sawyers received a mean salary of US$ 170 per month and their assistants were paid US$ 127.50. Grinders belong to the better paid workers with a mean salary of US$ 239 per month. Average wages of office workers amounted to US$ 127.50 per month. Classifiers and foremen were the best paid workers, with an average monthly wage amounting to US$ 340 and US$ 311.50 respectively. The average salaries for each category are presented in Table 6.5. For comparison similar data from other sources are added.

Unskilled forest workers employed by sawmills in the city were often better paid than their colleagues working in the sawmill. The average salary of chain-saw operators amounted to US$ 127.50 per month. Their helpers

were paid US$ 113. Drivers of skidders and other forest machines on average received US$ 184 per month. The main reasons for differentiating between the wages of workers in the forest and those in the sawmill were the heavier workload of the loggers, the greater risks and the need to stay away from home for some time. In addition to their basic wage, they receive a commission on the number of felled trees which could even double their basic pay. Such payments on a commission basis were also given to some categories of workers in the larger sawmills. Nevertheless, the increase relative to the basic wage in those instances generally did not exceed 15-30%.

Table 6.5 Average salaries for different categories of workers (US$/month)

Category	Browder (1984)	FIERO (1987)	Ros-Tonen (1989)
Foreman	?	339.27	311.67
Band sawyer	143.16	169.64	170.00
Assistant	99.20	135.71	127.50
Helper	85.95	89.06	96.25
Grinder	207.78	203.56	239.06
Circular sawyer	115.75	135.71	129.00
Classifier	?	?	340.00
Packer	?	?	99.17
Office worker	?	89.06	127.50
Truck driver	160.73	118.75	212.50
Chain-saw operator	100.45	?	127.00
Helper (forest)	89.85	?	113.33
Skidder operator	179.14	?	184.17

Note: Dollars not corrected for inflation.
Sources: Browder, 1986; FIERO, 1988; Author's field research, 1989.

In addition to cash wages, labourers may also receive benefits such as free housing, meals and transport. In this context, six of the interviewed workers (10%) mentioned life insurance and eight (13%) enjoyed free transport between their home and the sawmill. According to the interviews with sawmill owners, 30 firms provided housing at the mill site for all or a proportion of their employees, involving a total of 192 people. In the cities houses are usually only provided to workers recruited from other regions. The surveyed companies in Belém provide free housing for less than 1%

of their workers, whereas this percentage amounted to 4% of the workers employed in the sawmills of Santarém. In the colonization areas where the worker's home may be distant, it is more common to provide lodging to workers, as well as to supply free meals. Fifty per cent of all workers in sawmills along the exit roads from Santarém and the Transamazônica stay at the mill site during the week.

Wooden barracks are built to lodge forest workers when it is intended to exploit a tract of forest for more than a month. In the case of short term exploitation more simple accommodation is used, e.g. using tents. It is common to supply free meals to forest workers.

When they are formally employed, workers have the right to free health care at the INPS, which some of them consider to be an extra benefit provided by the employer. The reality is that in most places this health service is either absent or, at best, highly deficient.

Collective labour conflicts to improve working conditions are scarce. Most conflicts are individual cases and refer to incorrect or delayed salary payments and denied requests for wage increases. Nine of the interviewed workers (15%) had been involved in this kind of conflict.

Interviews with owners and managers show that another source of conflict is the Security for Time of Service Fund (*Fundo de Garantia por Tempo de Serviço*). This fund gives formally employed workers the right to a non-recurrent allowance in the case of dismissal without legitimate cause. In 11 companies (16%) the height of the allowance had been a recurring cause of conflict, which often had to be brought to court.

The membership of the Trade Union of Workers in the Timber Industry (*Associação Profissional dos Trabalhadores na Indústria Madeireira*) in Santarém numbered 285 in July 1989, corresponding to 33% of the total labour force in the city's timber industry.[12] Its objectives include contributing to the workers' being aware of their rights and struggling for better wages and working conditions, especially with regard to accidents at work. Moreover, the trade union wants to be on the alert for modifications

12. The percentage of the workers interviewed who were members of the trade union is higher (60%) due to the way the respondents were selected. To avoid interviews at the workplace, the trade union was chosen as the starting place for the selection of respondents. Further contacts were established through personal references. Though this method has the advantage that respondents express their opinions more freely, it may result in biases towards certain groups.

in the law and its implications for the workers. It also intends to be watch out for efforts to dodge the ban on log exports (NAEA, 1988; Souza, personal comment, 1989).

The workers interviewed who had decided to join the trade union had done so mainly because they felt the importance of collective organization in the struggle for their rights and for better wages. Personal contacts with workers who had previously joined the trade union play an important role in the decision to become a member. The main reasons for not joining the trade union were lack of interest (44%), recent entry in the timber industry (24%), ignorance of the existence of a trade union (8%) and lack of time (12%).

From the employers' point of view, the main labour problems lie in the high turnover of personnel, lack of skilled workers and absenteeism. These problems were felt respectively by 58%, 40% and 16% of the interviewed employers.

The high turnover of personnel is also reflected in the interviews with workers. One third of the interviewed labourers had entered the timber sector less than a year ago and 45% had been in their actual job for less than a year. Nearly 50% of the interviewed workers had had another job in the 12 months preceding the interview. In 57% of the cases that other job had also been for less than a year. Only nine of the interviewed workers (15%) had worked for more than five years at the same mill.

Employers tend to attribute the high turnover and absenteeism in large part to the employment opportunities in the gold-mines (*garimpo*). The workers are thought to leave for the *garimpo* in the hope of earning a lot of money in a short time. Most of them return speedily as they soon get infected with malaria. When they have recovered, they try their luck again, thus turning into a highly volatile labour force.

This explanation is only partly confirmed by data from the interviews with the workers. Only four of the 28 workers who had had another job in the year preceding the interview had gone to the gold-mines. The rest had worked in other sawmills (21%), in commerce (21%) and in service industries (18%). A more plausible explanation for the high turnover is likely to be found in a combination of the instability of the employment itself, the low wages versus the heavy workload, the risks of accident and the cultural background of the workers whose traditional survival strategies do not include wage-employment and fixed working-hours.

6.2.3 Timber exploitation in the colonization process

In the foregoing chapters we have already noted that timber exploitation or wood processing can create additional sources of income for farmers in colonization areas. In many cases the selling of roundwood or the establishment of a small sawmill prevents the failure of colonization as it broadens the means of subsistence where farming alone can provide hardly enough for survival. Most sawmill owners along the Transamazônica and the Santarém-Cuiabá road are not timber exploiters at heart but basically farmers who established a sawmill when they discovered that farming in Amazonia implied a miserable life (Ros-Tonen, 1991 and 1992). Uhl et al. (1991), who studied the social, economic and ecological effects of logging in Tailândia, a colonization area in eastern Pará, even suggested that this city would have failed as a colonization centre without the logging economy.

Timber exploitation also enables peasants to convert more rain forest into farming land than would have been possible without the logging activities on their land. As we have seen, roundwood is often exchanged for the use of a tractor or assistance in the construction of secondary roads. These roads open up the forest on their holding and make it easier to bring this land under cultivation. Thus, timber exploitation diversifies peasant activities and may result in the increasing income and welfare of small colonists. The other side of the coin is that timber exploitation contributes to the acceleration in deforestation rates by facilitating the clearing of forest for farming land.

Timber exploitation not only increases the viability of small-scale colonization but also that of cattle ranching on large estates. Large landowners try to compensate for the withdrawal of governmental financial support to cattle ranches in rain forest areas by selling roundwood or logging rights to timber companies (Uhl et al., 1992). By subsidizing the expansion of cattle ranches these timber sales promote the activity which is considered to be the major cause of deforestation in the Brazilian Amazon. Moreover, this practice contributes to the concentration of landownership and land speculation as clearing forest for pasture is a way of claiming land and preventing expropriation for the purpose of land reform (Hecht, 1989).

A third aspect of the timber industry's role in the colonization process is its contribution to the urban development of pioneer towns. As we have

mentioned earlier in this chapter, new towns may develop where sawmills attract and lodge labourers from other regions. Examples of towns which have developed around a sawmill were found by Volbeda (1984) in southern Pará. Two of the five pioneer towns in her study area - Rio María and Xinguara - owe their existence in large part to the establishment of one or more sawmills.

Another example is Tailândia in eastern Pará. During our fieldwork, the press reported on the lobby of sawmill owners from this town in acquiring public services. The number of sawmills in Tailândia had increased rapidly after the asphalting of the PA-150 in 1985 (Veríssimo et al., 1989). By 1989, the town was home to approximately 200 sawmills - some of them displaced from Paragominas - and its population had risen to 50,000. However, the city lacked essential services such as water, electricity, education and health care. In August of 1989, the Association of Sawmill Owners of Tailândia (AMATA) had started their lobbying to acquire these services.

The AMATA wrote an official letter to the Governor of the state demanding electricity supplies for the town and started negotiations with the telephone company for the installation of a telephone system (O Liberal, August 5, 1989). In September of that year, the AMATA, the Association of Industrial and Commercial Entrepreneurs of Tailândia and the Association of Sawmill Owners of Tucuruí formed a committee which presented a plan to the electricity company for the electrification of the region of Goianesia and Tailândia (O Liberal, September 14, 1989). A few days later, a group of five town-councillors had an audience with the state governor to complain about the total lack of infrastructure in the city. On that occasion the governor promised to initiate the construction of a primary school in the very same year and a health centre in early 1990. The requests for public services and the restoration of the roads were to be granted in the short and medium term (O Liberal, September 17, 1989). The Tailândia case provides an example of the catalyst role of the timber industry in the urban development on the frontier.

Whether or not such towns develop into stable settlements depends on the other economic activities which are undertaken. When the local economy virtually exclusively depends on the timber industry it is very likely that, in a later phase, these settlements will be transformed into ghost towns when the timber source is depleted. This is what happened to Roulim de Moura in Rondônia which enjoyed a 'mahogany boom' during the first

half of the 1980s (Browder, 1987). By 1988, many sawmills were being removed to the neighbouring municipality of Alta Floresta, as the result of the 'mahogany war' which broke out in the competition for increasingly scarce raw material (Groeneveld, personal comment, 1988).[13]

6.2.4 The destination of profits earned in the timber industry

> 'Export earnings only benefit the entrepreneurs. The people who actually cared for the forest are left with nothing' (leader of the Trade Union of Rural Workers, 1989).

Another aspect relevant to the evaluation of the timber industry's contribution to the development of the Amazon concerns the destination of profits earned by the exploitation of hardwood. Of particular relevance is whether the region and its population benefit from the profits gained in the timber business. In this section we highlight this question in two ways. First, we consider the profitability of wood-processing activities. Then we look at the way these profits are spent.

Various authors such as Browder (1986) and Uhl et al. (1991 and 1992), have estimated the profitability of logging activities in the Amazon. Browder, who focused on mahogany exploitation in Rondônia, concluded that profits of up to 43.6% were earned by the exporters of mahogany but that the producers of this timber were left with meagre or negative returns on their investment. Through their dominance of the timber trade, timber merchants were able to acquire mahogany sawnwood at prices below production costs. This had resulted in average returns on investment between 1981 and 1986 amounting to 28.5% for exporters (ranging from 13.8% to 43.6%) and a mere 1.5% for producers (ranging from -9.7% to 18.8%).

Uhl et al. estimated the profit margins of logging operations and wood-processing in Paragominas and Tailândia in eastern Pará. The profit margin of what they call a 'typical sawmill in Paragominas', which produces 4,300

13. The displacement of sawmills in this region is an older phenomenon. The increase in the number of sawmills in Roulim de Moura in the preceding years had partly been the result of the displacement of sawmills from the neighbouring municipality of Cacoal (FIERO, 1988). At the time, mahogany was still abundant in Roulim de Moura, which is located further inland from the Cuiabá-Porto Velho road (BR-364) than Cacoal.

m^3 per year, was estimated at 25.8%. For Tailândia they differentiated between sawmills with different log-use efficiency rates. In the case of sawmills with a log-use efficiency of 34% (3 m^3 of logs to produce 1 m^3 of sawnwood), the profit margin amounted to 18.5% during the dry season, which was not enough to stockpile logs and continue production during the rainy season. If the log-use efficiency amounted to 50% (2 m^3 for each cubic metre of sawnwood) the profit margin amounted to 40%.

These data suggest that, aside from variations from year to year and divergent levels of production efficiency, the scale of operation is an important factor in explaining why profitability may differ between different production units. For that reason, we distinguished between four output classes in estimating the profitability of the sawmills in our survey. In our estimates we started out from and adapted the models used by Uhl et al.. The method and results of these estimates are presented in Appendix 6.

The results of the estimates show that the owners of small sawmills, with a production of up to 500 m^3 per year (58% of the surveyed sawmills) earned a mean gross annual profit of US$ 3,956 in 1989. Of this amount - the equivalent of a profit margin of 15.6% - the owner's salary, depreciation and logs for the rainy season still had to be paid. Expressed in terms of the Brazilian minimum wage, this profit was the equivalent of less than four salaries (US$ 330) per month on an annual basis. Taking into account that the purchasing power of four salaries in Brazil is just enough to supply someone with their basic needs, it becomes clear that small sawmills have insufficient capital to invest in stocks of roundwood for the rainy season and that these marginal profits in the long term generally result in decapitalization.

The profitability of the medium sawmills and large sawmills in our survey - 29.9% and 28.3%, respectively - is somewhat similar to the results of the Paragominas case of Uhl et al.. The largest profits can be found among the companies producing 5,000 m^3 or more per year, which realize profits as high as 35% of the total value of production. In absolute terms the average profits in 1989 amounted to US$ 59,000 for medium sawmills, US$ 264,000 for large sawmills and US$ 2.3 million for the largest companies.[14]

14. A comparison with the estimates of Uhl et al. in terms of profits per unit of production suggests better results for the sawmills in our study area. In the case study of Paragominas, average production amounted to 4,300 m^3. This was 25% higher than the average of the large sawmills in our survey. Whilst the gross profit per unit of

A matter of concern with respect to the question as to whether or not the timber industry contributes to the economic development of the Amazon region, is where and how these profits are spent. It was difficult to gain insight into this aspect. Respondents were only willing to indicate roughly if profits were reinvested and if so, where and in which sector investments were made. No reliable data were obtained on the proportion of the profits that was reinvested.

For the owners of the smallest sawmills reinvestment options are limited. Surplus from timber production is primarily used for their livelihood, a minimum is used to sustain the sawmill and, if possible, some money is used to support their agricultural activities. Half of the owners of small sawmills - 21 out of 41 - intended to invest in agricultural activities; eight of them partly financed these activities with the surplus earned in timber production.

Profits earned by medium and large sawmills were large enough to allow investment beyond the level of subsistence activities. Eleven of the 13 owners of medium sawmills reinvested in the sawmill in order to expand and diversify production. Seven of them also reinvested in other economic sectors; mainly in agriculture and cattle-ranching.

The large sawmills in our survey primarily reinvested in the expansion and diversification of the production (six of the seven cases). In addition, profits were invested in cattle ranching, river transport and petrol stations.

The owners of large companies invested in large estates (four of the nine cases), other industrial activities (three cases), transport (one case), and - mainly because they were obliged by law - in sustainable forest management projects (five cases).

In all groups, profits were spent within the Amazon region.

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production in their Paragominas case amounted to US$ 48.20/m^3, the average for the large sawmills in our study was US$ 77.28/m^3. The sawmills in their Tailândia case, which, on average, produced twice the amount of the medium sawmills in our survey, realized a gross profit of US$ 36.70/m^3, versus US$ 56.60/m^3 by the medium sawmills in our survey. The estimate by Browder (1986) shows a profit of US$ 93.07/m^3 for mahogany exporters. The largest firm in his sample produced 23,500 m^3 in 1984, comparable with the average production of the large companies of Belém. In this case the outcome of both estimates show a remarkable similarity (US$ 2.2 million for the large company in Browder's sample versus US$ 2.3 million as an average for the largest sawmills in our survey).

To sum up, wood-processing seemed to be a lucrative activity except in the case of small sawmills. When less than 500 m^3 is produced on an annual basis, wood processing is a vulnerable economic activity for sawmill owners in the city. For owners of small sawmills in rural areas, wood processing is more an additional source of income along with farming whereby the profits earned can 'subsidize' their agricultural activities. In the case of medium and large sawmills, wood processing enables the entrepreneurs involved to lead a comfortable life and to expand their production and also to spread the risk of investments over various undertakings. The largest companies in Belém realize huge profits that make them rank among the major enterprises of Brazil.

6.3 Conflicts over land and forest resources

Through its operations in large tracts of forests and its connection with colonization and large estates, the timber industry has become a party in the numerous conflicts over land and resources which have accompanied the expansion of the frontier. Eight of the sawmills and timber companies in our survey (11%) had been involved in conflicts over land or forest resources. There are several examples of communities, where the population organized itself to defend its area and to impede the access of timber companies or their representatives.

The most notorious cases in our study area are the collective action of twelve villages along the Tapajós river against a timber company from Belém the case of two communities along the Arapiuns river - São Pedro and Curí - against another company from Belém, and the expulsion of a timber company from Santarém from Aruã, which is also located along the Arapiuns. Similar cases have been reported from the neighbouring municipalities of Oriximiná and Trombetas.

What these cases have in common is that the companies exploited tracts of forests which were considered to be public domain but which were in reality, the territory of local communities. The conflicts arose in the early 1980s when timber was exploited in tracts of forests which were utilized by the local *caboclo*[15] people for hunting, the gathering of non-wood forest products, logging for local needs and shifting cultivation. Or when a tract

15. The Portuguese speaking descendants of indigenous and white people, living in the inland villages along the rivers.

of forests was exploited which the community had regarded as their forest reserve for future utilization. People protested against the timber companies when they discovered that compensation for the trees - if it existed at all - was extraordinary low. When they became aware that they were being deprived of a valuable economic asset they started to demarcate the area which they regarded as theirs by making a trail through the forest. They no longer allowed timber exploitation within these limits and were ready to defend their area.

The violence accompanying these conflicts varied with the company's interests in the area. In the case of Aruã, the company left without further conflict when the community did not allow their activities any more. In other cases it was reported that local leaders of the Trade Union of Rural Workers (STR) were menaced and that gunmen (*pistoleiros*) were hired to keep people out of the forest.[16]

In the case of the company operating along the Tapajós river, the conflict has now been settled and the company respects the limits. Confronted with the trail after he was requested to visit the area in 1982, the owner was soon willing to sign a document in which was laid down that an area of 13.4 km inland had belonged to the communities. The total area involved a belt along the river of approximately 35 km in length between the villages Amorim, located near the mouth of the river Amorim in the municipality of Santarém, and Samaúma, south of Boím at the division between the municipalities of Santarém and Aveiro. Within this zone the company retained an area of 500 m wide from the trail to the riverside to enable the conveyance of logs. Furthermore, it agreed on maintaining the road that separated their exploitation area from that of the communities.

The case along the Arapiuns river is only partly resolved. The parties involved agreed upon a trail 20 km inland. Afterwards, the company made another one at 16 km which crossed the trail of one of the communities and interfered again with its territory. Further action on the part of the villagers is complicated as they are themselves divided on the issue. Some of them accept the situation because the trail facilitates transportation from the inland settlements to the main village at the riverside and because the company offers transportation by truck once a week. Others, who live in the

16. The threatening of local leaders was revealed in more than one interview on this subject; with respect to the presence of *pistoleiros* information was contradictory.

area bounded by the two trails, would prefer to resist the invasion of their territory.[17]

In other parts of the Amazon, it may also be the indigenous population who are affected by the activities of timber companies in their area. It is estimated that timber exploitation, together with the mining of gold, cassiterite and bauxite, is among the major economic enemies of the indigenous population (Gomes, 1988). Especially in the transitional semi-humid forests of Rondônia, the northern Mato Grosso, southern Pará and eastern Maranhão, where the most valuable and increasingly scarce mahogany can be found, the invasion of indigenous areas by timber companies is not uncommon. But illegal extraction is also reported from other areas where precious hardwoods are found. In 1988, an officer of the National Foundation for Indians (FUNAI) estimated that, if all timber extracted illegally from indigenous reserves in the state of Rondônia were traded legally, it would have yielded US$ 3.8 billion to the indigenous communities and US$ 641 million in taxes to the state (Author's research notes, 1988).

An analysis of cases reported in the press and in the documentation of organizations for indigenous peoples shows that three strategies are operated to extract timber from indigenous reserves. The first is the flagrant invasion of reserves by timber companies or their agents without the consent of the indians involved. One of the first documented cases of this kind dates from the early 1970s when the Guajá indians living in the forest reserve of the Serra do Tiracambu in the state of Maranhão had to flee from lumbermen and land speculators (Gomes, 1988). Invasions by timber extractors reported in the press during our fieldwork in 1989 involved the Guajá indians living in an extensive area between the municipalities of Montes Altos and Bom Jardim in Maranhão (O Liberal, July 22, 1989), the Guajá and Urubu-Kaapor indians living in the forest reserve of Gurupí, located in the border area between the states of Pará and Maranhão (O Liberal, August 15, 1989) and the Tembé indians living in the reserve of the Alto do Rio Guamá in

17. This kind of division within a community affected by timber exploitation is also reported in other cases. Whereas part of the community allows the presence of a timber company because they expect to benefit from transportation, a new road, employment and incidental gifts, another part resists because of the negative impact on local land and forest uses.

northeastern Pará (O Liberal, October 8, 1989).[18] The reserve of Gurupí, which has abundant cedro and ipê, was invaded by timber companies from Paragominas. The timber from the Alto do Rio Guamá reserve constituted 90% of the roundwood supplies of the sawmills in the municipality of Capitão Poço and its environs.

A second strategy for exploiting indigenous reserves is through the financing of occupiers (*posseiros*). In these instances timber companies do not participate directly in logging but they provide money to landless peasants who settle illegally in the reserves and encourage them to sell the timber. It was rumoured that this was the background to a conflict that flared up during our fieldwork in 1989, between *posseiros* and the Arara indians, who live in an area of 365,000 ha south of the Transamazônica in the municipalities of Uruará, Medicilândia and Altamira. The Arara, who had always tolerated the colonists who had settled at the northern fringe of their area, had resisted the occupation of 54 km^2 in the southern portion of their territory by some 100 colonist families since 1986. After previous efforts to expel the *posseiros* in 1987 and 1988, they tried to get the occupiers away in September of 1989 by burning their houses and animals. The *posseiros* subsequently encamped along the Transamazônica which they kept blocked for several days to draw the attention of the authorities to their problems (O Liberal, September 16 to 21, 1989).[19]

A third strategy for exploiting the timber resources in indigenous areas is to negotiate with the chief (*cacique*) or with individual members of a tribe to sell roundwood or logging rights. Gomes (1988) comments on the case of the Xikrin indians in Pará, who were paid US$ 140,000 in 1984 for the extraction of 8,000 m^3 mahogany. Similar cases are reported with respect to the Guajajara indians from the reserve Araribóia in Maranhão and the Kaiapó in the Gorotire reserve in the municipality of Redenção in southern Pará (Gomes, 1988; O Liberal, June 16, 1989; Diário do Pará, June 15, 1989). In the Javarí valley in the state of Amazonas, in the border

18. The fact that it is often the Guajá indians that are involved in these kinds of invasions of their territory can be explained by the fact that this tribe does have economic relations with Brazilian society (Gomes, 1988). Tribes which maintain economic relations with the dominant society are more often involved in formal agreements with the timber companies.

19. The blockade was located a few kilometres outside our study area, at the border between the municipalities of Uruará and Medicilândia. The colonists had destroyed the bridge along the river Mutum, which marks the border between the two municipalities.

area with Peru, timber is bartered for commodities or negotiated at extremely low prices (*'a preços de banana'*), whereby, in some instances, the indians are used as cheap labour. The sumauma and cedro logs are processed in sawmills located in the towns of Atalaia do Norte and Benjamin Constant in Amazonas and in a veneer plant located at the Peruvian side of the Javarí river (CIMI/OPAN, 1986).[20]

Frequently the FUNAI mediates in these negotiations and exerts pressure on the indians to sell timber in order to finance their basic needs and those of the FUNAI station in the area (Gomes, 1988). The role of the FUNAI in these transactions is often dubious. In some cases this institution negotiates without the indians' knowledge - as it initially did in the aforementioned case of the Xikrin indians - or accepts prices far below the market value of the timber concerned. In Rondônia, FUNAI's questionable involvement in the contracts for timber sales from indigenous reserves induced the local legislative assembly to set up a committee of parliamentary inquiry. The Attorney-General of the Brazilian state ordered that inquiries be undertaken to verify the facts and the responsibilities with respect to the contracts with timber companies (CNBB/CIMI, 1988).

In the light of the functioning of the FUNAI, little is to be expected from the decree to regulate timber exploitation in indigenous areas which was being drafted in 1988 by this institution and the IBDF. According to the preliminary version of the regulation, the exploitation of timber resources in indigenous areas would only be allowed under the following conditions:

1. That the full consent of all the indigenous communities living in the area be obtained.
2. That a management plan based on a forest inventory be carried out by the IBDF in order to minimize ecological damage.
3. That an investment plan for the money generated by the exploitation of timber resources be signed by both the indians and the FUNAI.

The objective of the decree was that indigenous people obtain better returns

20. The expansion of extractive activities is the principal threat to the physical and cultural integrity of the approximately 3,000 indians who live in the Javarí valley. In addition to the invasions by loggers and unfavourable arrangements over timber sales, the existence of various tribes is also jeopardized by the exploitation of latex, prospecting for natural gas by the state company Petrobrás and the re-opening of the Perimetral Norte road and the colonization projects that accompany it. Little or no progress has been made in the demarcation of the indigenous area (CIMI/OPAN, 1986).

on the logging contracts.

The exploitation of timber resources in indigenous areas - whether or not with the consent of the indians involved - is generally judged unfavourably as it destroys the environment on which the indians depend for their livelihood. Whereas the invasion of indigenous areas provokes violence, contracts for timber sales threaten the cultural and social identity of the indians and lead to the compromising of leaders and the underselling of resources (CNBB/CIMI, 1988). In the case of isolated groups with no previous contacts with white people, the invasions have resulted in the contracting of diseases such as influenza, tuberculosis and malaria to which the indians have no resistance and from which they die (Gomes, 1988). According to a news item in the regional newspaper, the decimation of Arara indians living near Uruará, for example, resulted in the reduction of the group from 200 families in 1980, when they were contacted for the first time by the FUNAI, to 80 individuals in 1989 (O Liberal, September 18, 1989).[21]

Serious conflicts may also arise when a timber company is not only interested in the timber resources of a tract of forest but also in its actual ownership. This may be the case when the enterprise wants to safeguard a timber source for the future or when it combines timber exploitation with agricultural activities. In a frontier region such as Amazonia landownership is frequently disputed as many occupiers do not have legal title to the land, many titles are false, demarcations are vague and claims are overlapping.

The basic problem in many land disputes is the distinction between the holder of a title (*proprietário*) and the occupier (*posseiro*) who actually lives on the land and cultivates it. According to Brazilian law, the latter may claim the right to land through its appropriation (*direito de posse*) after one year and one day. Many conflicts arise from competing claims by title-holders and the *de facto* occupiers.

In many frontier regions, especially in eastern and southern Pará, owners of timber companies take advantage of the uncertainty created by these disputed property rights. They encourage *posseiros* to invade an area,

21. Unfortunately, we were not able to check this with other sources. It is rather strange that the reduction of the group is illustrated by comparing the number of families with the number of individuals ten years later. If these data are correct, it would imply that by now they will be totally extinct.

extract the trees and sell the wood to them which then enables them to exploit a timber source which they do not possess. More often than not, the *posseiros* are the losers in the end as they lack the resources and the political power to gain a definitive title. The use of violence to expel them from the land is one of the intrinsic features of the pioneer frontier (Foweraker, 1980).

Table 6.6 Area of forest tracts privately owned by surveyed sawmills

Area	Number of sawmills Abs.	%
0 ha	45	63.4
1-100 ha	4	5.6
101-500 ha	7	9.9
501-1,000 ha	1	1.4
1,001-2,500 ha	3	4.2
2,500-5,000 ha	3	4.2
5,000-10,000 ha	1	1.4
10,000-50,000 ha	4	5.6
No response	3	4.2
Total	71	100.0

Source: Author's field research, 1989.

As most sawmill owners are interested in the timber resource rather than the actual ownership of the land, it is only a few large timber companies that play a role in the concentration of landownership. The majority of the sawmill owners have no forest areas of their own or they possess small forest tracts of 500 ha at most (Table 6.6). Sawmills with larger forest areas either form part of a *fazenda* or they are large companies, which are obliged to manage the forest on a sustainable basis if their roundwood inputs total more than 10,000 m^3 per year. The *fazenda* sawmills in our study area were located on private properties of up to 2,500 ha in extent. These areas were not specifically acquired for timber exploitation. In all these cases, sawmilling was a secondary activity. The largest private forest areas, covering more than 5,000 ha, were owned or taken into possession with the specific purpose of logging by large companies from Belém (four cases) and Santarém (two cases). The maximum area owned by these companies

amounted to 40,000 ha.

For Amazonia as a whole, there are several examples of extremely large landholdings belonging to wood-processing industries. The plywood industry of MANASA Ltda. in the state of Amazonas, proprietor of 4,302,190 ha is the largest private landholder in Brazil. In the same state several other timber companies can be found with extensive areas, such as APBLUP-Agro Florestal Amazônia S.A. (2,245,623 ha), Morães Madeireiras Ltda. (577,336 ha), Maderex Madeiras do Amazonas S.A. (362,490 ha) and Madeireira Itacoai S.A. (174,582 ha). In the state of Pará one of the major landowners among the timber companies is the North-American enterprise Georgia Pacific Co., holder of 400,000 ha. In the state of Amapá the Japanese company Toyomenka and the Brazilian group that took over what had previously belonged to the Dutch company Bruynzeel possess approximately 300,000 ha and 200,000 ha, respectively. An example from the Mato Grosso is the area of 300,000 ha belonging to Atlantic Veneer, a company which originates in the United States (Hagemann, 1985; IBASE, 1985; Rankin, 1985; Oliveira, 1987 citing Irene Garrida Filho).

6.4 The involvement of local people in Amazonian forestry development

In recent development debates, it has been increasingly acknowledged that development implies the increasing power of the poor to control and act upon their own development process (Wiersum, 1988/89; Edwards, 1991; Ros-Tonen & Custers, 1992). This suggests that the local poor should be consulted via their organizations with respect to any development and investment plans that may affect them. This also holds true for forestry and the forest based industries. In the FAO Tropical Forestry Action Plan, for instance, it is stated that 'the establishment of a forest industry, without due consideration being given to the traditional uses of the forest, may be counter-productive' (FAO, 1985:32). The plan's recommendations with respect to the involvement of the local population state that the people concerned are to be informed well in advance of the implementation of an industrial project. Through existing local organizations they could be involved in the implementation of the project, in the raw material supply to the sawmill, and ultimately in the ownership of the enterprise. Though not all of these recommendations can be applied to the private sector, they

illustrate the ideas behind the issue of the people's involvement in the timber industry.

The question as to whether local organizations were consulted before wood-processing industries were established in our study area has to be answered in the negative. Policy concerning the timber industry was made and implemented from above. Investment decisions were largely taken outside the Amazon region, as most entrepreneurs originate from southern Brazil. Nonetheless, some popular organizations in the region have clear ideas with regard to the actual and desirable impact of the timber industry. A representative of the Group for the Defence of Amazônia (GDA) in Santarém, for example, expressed the following opinion:

> 'It is not impossible to exploit timber in a rational manner. It must be possible to utilize the forest without destroying it. If wood were extracted selectively, if technicians studied and identified the useful trees, if trees were replanted and if production were oriented towards the local market, the timber industry could be beneficial to the region' (member of the GDA, 1989).

However, the existing situation in the timber industry gives rise to a number of objections on the part of social organizations. These objections, partly illustrated in the foregoing sections, can be summarized as follows:[22]

1. Actual extraction methods result in the destruction of the forest and to the extinction of certain species. Some of these species are important to the local subsistence economy as they provide non-wood products and bear fruits that attract game.
2. It is impossible to grow anything at places where heavy machines were used for at least twenty years.
3. Timber exploitation encourages the transformation of the forest into pasture and enables small peasants to clear more than they used to do.
4. Large companies support and perpetuate an exploitation system in which profits are more important than the quality of human life.
5. In many villages timber companies buy land at low prices from

22. Taken from interviews with representatives of several social organizations, such as the trade union for workers in the timber industry, the Group for the Defence of the Amazon (GDA), the Pastoral Commission for Human Rights, the Trade Union of Rural Workers (STR) and leaders of communities in the interior.

peasants, who subsequently become the cheap labour force for those companies.

6. Local people are deprived of a future timber source. When paid for the timber, either in money or in sawnwood, their returns are low.
7. The timber industry does not meet local needs. Although wooden houses are the most suitable for the region, people cannot afford them as prime hardwood is exported at prices beyond the resources of the local people to pay.
8. The timber industry provokes a large number of labour accidents for which it fails to assume enough responsibility.

On some occasions, suggestions have been put forward by popular organizations about how to make the timber industry more beneficial to the region and its population. In this context, two proposals deserve special attention. The first one is part of a proposal for a regional development policy for the Amazon region, which was written in 1989 as a discussion paper for the Workers' Party (PT) (Grupo de Trabalho Amazônia, 1989). It was taken further by a working group consisting of people engaged in the popular movement and scientists attached to the Federal University and the Faculty of Agricultural Sciences of Pará. The working group advocated the *sustainable* utilization of natural resources, directed at the region's socio-economic development and the improvement of the living conditions of the most marginalized part of the population.

The paper places the development of the timber industry in the wider context of land-use planning and environmental policy. It advocates a policy which guarantees the multiple and sustainable utilization of forest resources in such a manner that the forestry economy and the production chains associated with it turn into a catalyst for regional development. To this end, research on forest management and forest resources should be intensified. The working group pleads for strict controls on the observance of regulations on timber production and trade, as well as for rigorous controls and sanctions on the illegal exploitation and trade in endangered and protected species. In order to prevent the indiscriminate exploitation of the forest, the working group recommends fixing a maximum number of sawmills per municipality.

Within this context, the development of small and medium forest industries should be encouraged, focusing on the production of foodstuffs (sweets, juices, compotes), pharmaceutical products and timber (furniture,

joinery). Local forest industries should be protected and the local production of timber end-products, such as furniture, wooden window frames and doors, should be stimulated (Grupo de Trabalho Amazônia, 1989).

A second proposal with respect to the timber industry was made to the Ninth National Congress of Workers in the Construction and Furniture Industry, held in Belém from August 31 to September 3 in 1989. At this congress, in which representatives of workers in the timber industry also participated, the following priority goals were formulated to protect the Amazon, its people and the workers in timber-based industries (Carta de Belém, September 3, 1989):

1. The immediate demarcation of indigenous areas.
2. The orderly occupation and exploitation of the Amazonian territory.
3. Elaboration of a forest policy for the Amazon, with the demarcation of new conservation areas, the implementation of a land reform plan and the prohibition of log exports.
4. As inflation impedes development, reduces the labour market and negatively affects the purchasing power of the workers, rigorous measures should be taken to reduce the public deficit and the foreign debt.
5. Resources must be employed to meet the basic needs of the country, in health care, sanitation, education and housing.
6. The trade union must exercise itself to achieve that protected labour relations mean job security and the integration of the workers in enterprises, sharing in the profits and exercising power within management.
7. In order to work and live normally, more preventive measures are required to prevent labour accidents. Social welfare (*Previdência Social*) needs to be adjusted in order to guarantee the health of the workers.

These proposals show that local people are in favour of the local processing of wood and non-wood forest products provided that (1) it is situated within a wider framework of land-use planning and forest policy, (2) exploitation is sustainable and controlled, (3) indigenous areas are protected, (4) production is primarily oriented towards local needs, and (5) workers are guaranteed decent labour conditions, including being integrated in the management.

6.5 Summary

In this chapter we have dealt with the role of timber-based industries in the socio-economic development of the Amazon region. Seen from the perspective of its income-generating effects, the timber industry plays an important role in the region as a source of non-agricultural employment. For colonists, the selling of trees or roundwood and wood processing can subsidize their agricultural activities and create additional sources of income. Profits earned in the timber industry are generally reinvested in the region itself both in timber production and other economic activities.

The other side of the coin is that these profits are frequently earned at the expense of the local poor, for whom the benefits are negligible. We have seen that the inland communities are being deprived of a valuable economic asset and a future timber source for little or no return. Timber companies and their agents are also responsible for being a major threat to the physical and cultural integrity of indigenous people, by their intruding in indigenous areas or through undertaking negotiations on timber sales which give extremely unfavourable terms to local people. Logging also negatively affects hunting which is a major source of protein for the indigenous and *caboclo* people. The extent to which timber production meets local needs is also limited. Production is mainly oriented toward external markets in other parts of Brazil or abroad. Distant consumers pay higher prices than local people can afford. Hence, it is inferior quality or lesser known species that are sold on local markets. With respect to the working conditions, too little is done to prevent accidents at work. For the workers, the constant risk of being injured is felt as a greater problem than the low wages or the heavy workload.

With respect to these negative effects it is important to distinguish between the small sawmills on the one hand and the medium and large ones, on the other. It is the first group which, though only contributing marginally to the region's total production, comprises the majority of the sawmills. This group is most the integrated in the local economy in the sense of being linked to small-scale farming and to having its orientation towards local consumers. As the result of their small scale of operation, the aforementioned negative socio-economic impacts hardly apply to these sawmills, except for the qualitative aspects of employment. The medium and large enterprises on the other hand, are more important as a source of employment and a source of capital for investments in other economic activities.

The final socio-economic aspect considered in this chapter is the involvement of local people in development and investment plans concerning the timber industry. We illustrated that social organizations in our study area - which had no voice in development and investment plans - have strong objections to externally oriented, large-scale wood-processing industries, especially with respect to their ecological and exploitative effects. But they are not opposed to timber-based industries per se. Local processing of forest products is accepted, provided that forest exploitation is sustainable, production is oriented towards local needs, logging activities are strictly controlled and the rights of indigenous and other rural people, as well as those of the workers are rigorously respected. The social organizations also plead for comprehensive land-use planning and forest policy as a framework to provide a framework for the development of the timber industry.

7 The Amazonian timber industry in international perspective

In recent years, the question of the sustainability of timber exploitation has often been related to international trade in tropical hardwood. Various efforts are being undertaken to bring about forest management and more responsible logging practices by intervention in the timber trade. To assess the implications of these measures for the situation in the Brazilian Amazon, it is important to know how the timber industry is related to the international market for tropical hardwood.

In the first part of this chapter, we will analyse the domestic and international market for Amazonian timber using data published by Brazilian institutions and the Food and Agricultural Organization (FAO). These data will be compared with the results of our survey among sawmills and timber companies in the state of Pará.

In the second part of this chapter, we will present two initiatives to promote sustainable forest management through the international timber trade: the International Tropical Timber Organization (ITTO) and the campaigns for a ban on tropical hardwood from forests which are not managed on a sustainable basis. Finally, we will discuss the possible influence of these initiatives on the prospects for sustainable forest exploitation in the Brazilian Amazon. In doing so, it is also important to consider what other causes apart from commercial logging, in fact influence the destruction of the Amazonian rain forest.

7.1 The domestic market

Reliable quantitative data on the internal trade of Amazonian timber are scarce. One of the first attempts to assess the national demand and how it would develop between 1979 and 1985 was undertaken by the former IBDF (Machado et al., 1978). But this study cannot be used for the analysis of specific trade flows from the Amazon as it makes no distinction between the regions of origin. Moreover, the study is limited to sawnwood and makes no distinction between timber from natural or from man-made forests.

Two other sources of information could be found at the IBDF and the federal taxation office (*Secretaria da Receita Federal).* Data from these

sources are based on tax forms, to be completed by any person or enterprise engaged in the trade of forest products. As the amount of the levy to be paid is related to the volume which is commercialized, these data are inherently unreliable. Moreover, these data do not show whether the products are sold in the region of destination, or if they are exported from that region to foreign markets. Data registered at the regional IBDF office in Porto Velho, for instance, suggest that virtually all timber produced in Rondônia is destined for markets in southeastern Brazil. A large part of this timber is, however, transported to the state of São Paulo to be exported from the port of Santos.

Table 7.1 Brazilian production and export of non-coniferous sawnwood

Year	Production (x 1,000 m^3) (a)	Export (x 1,000 m^3) (b)	Domestic consumption (a-b)/a.100%
1950	651	45	93.1
1955	3,700	38	99.0
1960	2,900	17	99.4
1965	2,700	65	97.6
1970	3,500	147	95.8
1975	4,332	187	95.7
1980	7,738	622	92.0
1985	9,397	421	95.5
1989	9,795	533	94.6

Source: FAO, World Forest Product Statistics and Yearbook of Forest Products, various issues.

The scarce sources of information on specific trade figures for Amazonian hardwood indicate that, traditionally, around 90% of the Amazonian timber was sold to domestic markets (Nahuz, 1982). Data from the FAO World Forest Product Statistics and the Yearbook of Forest Products (various issues), which also includes data about hardwood from other parts of Brazil, show that the domestic market absorbs an even larger share of the total output of Brazilian hardwood (Table 7.1).

Mercado (1980), who used data from 1978, found that one third of the Amazonian timber production was sold in the region itself and 55% in other parts of Brazil, leaving 12% for export. Outside the Amazon, the main outlet for Amazonian hardwood is to be found in the densely populated

Northeast and the industrialized and populous Southeast (27% and 25%, respectively, of the total domestic trade flow). According to the same author, the central-western states account for 9% of the national market for Amazonian hardwood and southern Brazil for 2%.[1]

Data from the IBDF (1984) - which are incomplete because of the lack of data about the trade from the states of Rondônia and Acre - suggest that 31% of the Amazonian timber production for the national market is sold in the Amazon region itself, 32% in the Southeast, 21% in the Northeast, 11% in the South and 5% in the Central-West.

Notwithstanding slight differences in the share of the various regions in the total national outlet, these sources are rather similar with respect to the portion that is sold within the national boundaries and the major role of markets in northeastern and southeastern Brazil.

Data provided by the sawmills included in our survey do not allow us to calculate the respective share of the various regions in the total market for their production. The importance of the different markets can only be expressed in terms of the number of enterprises which operate in them. Of the 60 sawmills in the Santarém region, 27 sell part of their production outside the Amazon. These enterprises sell their produce in the Southeast (82%), in the South (22%) and in the Northeast (7%). The surveyed companies in Belém market their products mainly in the Southeast (the states of Rio de Janeiro, Espírito Santo, Minas Gerais and São Paulo) and abroad. Whereas in the aforementioned studies the northeastern markets seem equally as important as those in the Southeast, the production for the national market of the sawmills and timber companies in our survey seems to be oriented more explicitly towards the southeastern states.

Another difference between the data from our survey and those from the aforementioned sources lies in the smaller portion of the production that is sold in domestic markets.[2] All surveyed enterprises together export 43%

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1. See Map 0.1 (inside cover) for the regional division of Brazil.
2. It is possible that the export ratio in the state of Pará is higher than for the Amazon region as a whole as this state provides 88% of the total Amazonian timber exports (Vantomme, 1991). The difference between the results of our study and other sources is very large in this respect. Against the background of the observation of local people that most hardwood is marketed outside the region, it seems unlikely, however, that the respondents have overestimated the share of the export market in the total outlet of their production. Also the inclusion of indirect exports cannot explain the difference, because

of their production. The Amazon region absorbs 9% of their total production and 48% is marketed in other regions within Brazil (Table 7.2).

As we have seen in the previous chapter, it is important to differentiate between sawmills with different output levels. The sawmills in the Santarém regions with an annual production of up to 500 m^3 sell the bulk of their production in their immediate neighbourhood or in other parts of the Amazon region (52% and 35%, respectively). Only 13% of their production reaches markets outside the Amazon through the exports of large timber companies which buy their production.

Sawmills operating on a intermediate scale - with a production ranging between 500 and 2,500 m^3 a year - are notably less oriented towards local and regional consumers (37% of their total production). A small amount (8%) is sold on domestic markets outside the Amazon region. That leaves more than half of their production (55%) for the international market, either exported directly (8%) or via export firms (47%).

The largest sawmills in the Santarém region, which produce more than 2,500 m^3 per year, are mainly oriented towards markets outside the Amazon, both national and international. Whereas only 7% of their production is marketed within the Amazon region, 27% is merchandised elsewhere in Brazil and 66% finds its way abroad.

These data show that the distance to the consumers increases with higher production volumes. Both the required standards for product quality and the financial conditions needed for exploring external markets play a role in this. These factors constitute obstacles for small and medium-sized sawmills, which can only partially be overcome through exporting indirectly through large companies which upgrade the product to export standards, if necessary.

The large companies in Belém also sell a minor part of their production (4%) on local and regional markets. Contrary to the large firms in Santarém, however, they merchandise a larger proportion of their production in the non-Amazonian national market than they market abroad (56:40% compared with 27:66% for the largest enterprises in Santarém). As we have explained in the previous chapter, this might be attributed to the different conditions of the roads connecting both cities to markets elsewhere in Brazil.

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even if these indirect exports are considered as sales on the national market, the share of exports is still much larger (33%) than the 10-12% found in other sources.

Table 7.2 Buyers and markets according to location and production class of the sawmills

Market	Location and production class: Santarém (region) Small	Medium	Large	Subtot.	Belém Large	Total
	(% of total production)					
Individual consumers	48%	22%	7%	18%	38%	34%
Wholesale and retail traders	32%	5%	22%	19%	37%	34%
Wood-processing industries	2%	15%	14%	12%	10%	10%
Construction companies	5%	3%	16%	11%	4%	5%
Export firms	13%	47%	8%	19%	7%	9%
Importers	-	8%	33%	21%	4%	8%
Total	100%	100%	100%	100%	100%	100%
Local	52%	30%	7%	20%	4%	7%
Regional	35%	7%	-	8%	-	2%
National	-	8%	27%	17%	56%	48%
International	13%	55%	66%	55%	40%	43%
Total	100%	100%	100%	100%	100%	100%

Source: Author's field research, 1989.

As can be seen from Table 7.2, we have distinguished several categories of buyers:

- Individual, mostly local, consumers of timber used in (self-)construction and fencing. In the case of export this category may also include large companies abroad which buy directly from the timber company.
- Wholesale and retail traders.
- Wood-processing industries such as manufacturers of parquet, furniture and joinery.
- Construction companies and building contractors.
- Large timber companies which mediate in exportation.
- Importers, generally wholesale traders.[3]

3. The difference between individual (commercial) consumers abroad and importers is not always clear. In the case of a wood-consuming company, an importer was generally seen as an individual consumer. In the case of wholesale traders, in general, the term 'importers' was used.

The table shows that some differences exist between sawmills with different output levels with respect to the relative share of the various types of buyers. Individual consumers constitute the main outlet for the smallest sawmills to whom they either sell directly (48% of their production) or via timber-yards (32%). This market segment is, however, less significant for the largest sawmills in the Santarém region.

In our study area, commercial users such as wood-processing industries and construction companies, are an important market segment for large sawmills, and - as far as the wood-processing industries are concerned - for the medium sawmills. In the outlet of the production of small sawmills these buyers play very little role.

Direct sales to importers abroad seem to be virtually exclusively realized by large companies. Small and medium sawmills which produce for foreign markets generally export indirectly through large export firms.

With respect to the marketing channels of the largest sawmills in Santarém and the large companies in Belém there are some differences which can be attributed to the larger scale of operation of the Belém companies. For the latter, individual consumers play a more significant role than for the first and this can be explained by their capacity to deal directly with large commercial users abroad and by their better developed network of agencies in other parts of Brazil.

Another difference between the large companies in Santarém and those in Belém lies in the importance of the wholesale traders on the domestic market. Whereas the first apparently sell more often to wood-processing industries and construction companies directly, the latter more often make use of the wholesale trade to reach the market segment of commercial timber-users.

Summarizing, the following conclusions can be drawn with respect to the domestic market:

- Although other sources indicate that as much as 88-91% of the Amazonian timber production is absorbed by the domestic market, data from our study suggest that a substantial part of the production finds its way abroad (43% of the total production of the surveyed sawmills).
- Within Brazil, the principal markets for Amazonian hardwood are located in southeastern and northeastern Brazil, the latter being less significant for the sawmills in our survey. With the exception of large sawmills, the Amazon region itself is a significant outlet for the production.
- The marketing channels which are used vary with the production volume.

7.2 Amazon timbers on the world market

Despite its extensive areas of tropical rain forest - 30% of the world's reserve -and the sharp increases in production of the last decades, Brazil plays only a marginal role in the international tropical hardwood trade. Vantomme (1991) estimated that in 1988, 3% of the Amazonian sawnwood production, 26% of the veneer production and 67% of the plywood production was exported.[4] In 1989, the Brazilian share in the world trade in tropical hardwood amounted to 0.2% for saw- and veneer logs, 4.6% for sawnwood and 5.5% for wood-based panels (FAO, 1991).[5]

It has been virtually impossible for Brazilian hardwood to compete with timber supplies from Malaysia - which dominates the tropical hardwood market with a share of 78% in the log exports and 45% in the non-coniferous sawnwood exports from developing countries - and Indonesia, which exports 24% of all tropical broadleaved sawnwood (FAO, 1991). Exploitation costs in Amazonia are 50-100% higher than in Asia and Africa. In the first place, the greater heterogeneity of the Amazonian rain forest results in low densities of marketable trees, making exploitation more costly in comparison with the more homogeneous forests elsewhere. Secondly, the inaccessibility of large parts of the region results in higher transportation costs. Other factors which contribute to the poor performance of Amazonian timber species on the world market are that many of them are unknown on foreign markets, are hard to saw and generally have a dark colour, whereas European and North American consumers generally prefer the lighter colours of Asian wood (Fearnside, 1990).

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4. Tropical hardwood is marketed in several forms. Trade statistics usually distinguish between logs, sawnwood and wood-based panels. Logs are lengths of roundwood, which can be roughly squared and which are to be used in sawmills and veneer plants. Sawnwood is the product of basic processing whereby logs are sawn lengthwise. It is sold as beams and planks of different sizes for use in the construction industry, shipbuilding, carpentry and the furniture industry. Decorative and non-decorative veneer sheets are produced by peeling or slicing the logs and are used for the manufacture of plywood or furniture. Other wood-based panels include plywood, particle board and fibreboard.

5. Expressed in percentages of world totals - tropical and temperate zones taken together - Brazil's share in the world exports of non-coniferous saw and veneer logs amounted to 0.14%, whereas it contributed 3.1% to the worldwide exports of broadleaved sawnwood and 2.4% to the global exports of wood-based panels (FAO, 1991).

A closer look at the composition of Brazilian wood-based exports reveals that,in 1989, the total export value of US$ 1.7 billion - 5.1% of total Brazilian export revenues - was mainly determined by the export of pulp (35%) and paper (39%) (Table 7.3). For these products, which are principally made from *Eucalyptus* and *Pinus* from plantations in southern Brazil, no native Amazonian wood species are used. The one fifth of the wood pulp exports which comes from Amazonia originates entirely in the Jarí enterprise in the state of Pará, where 102,109 ha of rain forest and savanna were cleared for the planting of *Eucalyptus*, *Gmelina* and *Pine* (Vantomme & Peixoto, 1985; Pinto, 1986). Other wood products mentioned in Table 7.3 which do not involve Amazonian wood species are fibreboard, which is made of *Eucalyptus*, and particle board, which is produced from pine and mixed species. All these species come from plantations in southern and southeastern Brazil (Vantomme & Peixoto, 1985; Nahuz, 1988).

Table 7.3 Brazilian exports of wood-based products (1989)

Product	Value (x US$ 1,000)	%
Sawlogs and veneer logs (non-coniferous)	3,824	0.2
Coniferous sawnwood	32,836	1.9
Non-coniferous sawnwood	169,236	9.6
Veneer	40,857	2.3
Plywood	136,651	7.8
Particle board	1,708	0.1
Compressed fibreboard	65,711	3.7
Mechanical wood pulp	2,078	0.1
Chemical wood pulp	622,885	35.4
Newsprint	10,382	0.6
Printing and writing paper	306,661	17.4
Other paper and paperboard	367,059	20.9
Total	1,759,888	100.0

Source: FAO, 1991.

It is mainly the exports of non-coniferous saw and veneer logs, the broadleaved sawnwood, the veneer and plywood that originate to a large extent in Amazonia. Virtually all hardwood logs originate from the Amazon, but they are exported on a small scale due to an export ban issued in 1973. For some years, an exception was made for logs from areas to be

flooded due to the construction of hydro-electric plants and for little known species from clearings for large mining and agricultural projects, in order to promote their acceptance on foreign markets. But in 1990 the export of logs was banned once again.

On the basis of data from 1983 Vantomme & Peixoto (1985) estimated that 75% of the Brazilian sawnwood exports consisted of Amazonian wood species. Exported veneers are for 86% produced using Amazonian wood species such as muiratinga (*Maquira coreacea*), sumauma (*Ceiba pentranda*) and virola (*Virola surinamensis*) (Sabbá, 1984; Vantomme & Peixoto, 1985; Nahuz, 1988).

It is more difficult to assess the contribution of raw material of Amazonian origin in plywood, which can be made of both hard and softwood species. In southern Brazil the use of Parana pine and other softwood species in plywood manufacturing still predominates, but the share of Amazonian hardwood species in its production is steadily increasing with the growing scarcity of native species. If we assume that 25% of plywood production in the Southeast and South is made from Amazonian wood species and given that 42% of all plywood exports are directly exported from the Amazon region (Vantomme & Peixoto, 1985) we can conclude that approximately 65% of total plywood exports involve wood species from the Amazon.

Combining these percentages with the data in Table 7.3, the share of Amazonian wood species in the total value of the exports of wood-based products can be estimated at 14.5%, corresponding to 0.7% of total value of Brazilian exports. The major part (54%) of the value of timber exports which originate in the Amazon is obtained from exports in the form of sawnwood.

One of the most striking features of the export market for Amazonian hardwood is its extreme selectivity. Whereas currently over 250 wood species are exploited in the Brazilian Amazon region, only ten species find easy acceptance on foreign markets. Mahogany (46%) and virola (21%) represent two thirds of the tropical hardwood exports (Vantomme, 1991). Other hardwood species of some importance are jatobá (6.3%), andiroba (2.9%), ipê (2.1%) and sucupira (1.4%). Cedro, angelim vermelho and

tatajuba contribute approximately 1% each (Banco do Brasil/CACEX, presented in Vantomme, 1991).[6]

The same pattern is reflected in the export figures from the states of Pará and Amapá which account for some 90% of all Amazonian timber exports. These states exported 72 wood species in 1988, with mahogany accounting for 45% and virola for 25% of the total volume. The ten most exported wood species taken together constitute 94% of the total timber exports from these states (Table 7.4).

Table 7.4 List of wood species exported from the states of Pará and Amapá (1988)

Common name	Botanical name	Volume in m^3	%
Mahogany	*Swietenia macrophylla* King	155,330	44.8
Virola	*Virola Surinamensis* (Rol.) Warb.	84,829	24.5
Jatobá (Locust-tree)	*Hymenea courbaril* L.	29,030	8.4
Pau amarelo (Satinwood)	*Euxylophora paraensis* Hub.	18,624	5.4
Andiroba	*Carapa guianensis* Aubl.	12,435	3.6
Sucupira	*Bowdichia* spp./*Diplotropis* spp.	6,566	1.9
Angelim vermelho	*Dinizia excelsa* Ducke	5,822	1.7
Cedro	*Cedrela odorata* L.	5,521	1.6
Ipê	*Tabebuia longiflora* (Bur.) Stend.	4,859	1.4
Tatajuba	*Bagassa guianensis* Aubl.	4,638	1.3
Others		19,296	5.6
Total[1]		346,950	100.0

1. Roundwood, manufactures and wood-based panels excluded.
Source: AIMEX, 1989.

The principal foreign markets for Amazonian hardwood are located in the United States, the United Kingdom and the Caribbean Islands (Dominican Republic, Puerto Rico, Barbados, Trinidad and Tobago), which absorb 21.0%, 19.2% and 6.9%, respectively, of the total volume of Brazilian tropical timber exports (FAO, 1991).[7] Together, the EC countries

6. For the botanical names of these species, see appendix 3.
7. The volumes of broadleaved sawnwood, veneer and plywood taken together.

(especially the United Kingdom, Spain and Italy) account for over one third of the Brazilian sawnwood and plywood exports.[8]

The small volume of Brazilian log exports is mainly sold to China (89%) and Japan (10%) (IBDF, 1985). Non-coniferous sawnwood is mainly absorbed by markets in the United States (30.6%) and the United Kingdom (16.3%). Other important consumers of Brazilian broadleaved sawnwood are Spain (11.1%) and Italy (3.4%).

In 1989 veneer was principally exported to the United States (66.1%), whereas the main consumers of Brazilian plywood were the United Kingdom (26.4%), Latin American countries - unspecified by the FAO but, as can be derived from other sources, mainly the Caribbean Islands - (18.1%) and Saudi Arabia (6.9%) (FAO, 1991).[9]

The same pattern of export flows from Brazil is reflected in data provided by the Association of Exporting Timber Industries of the States of Pará and Amapá (AIMEX) concerning the exports from the states of Pará and Amapá during the first half of 1989. The destination of sawnwood exports during that period were the United States (37.7% of total volume), the United Kingdom (20.9%), Northern Europe (9.5%) and the Caribbean Islands (7.6%).

Veneer from Pará and Amapá was predominantly exported to the United States (91.9%). Other destinations were, Northern Europe (5.5%), the Mediterranean countries (2.0%), the Caribbean (0.5%) and the United Kingdom (0.1%). Plywood was marketed to the Caribbean region (42.4%), the United Kingdom (29.0%), the United States (20.8%), Northern Europe (6.7%) Ireland (1.0%) and the Mediterranean region (0.2%).

Japan, which is the world's largest importer of tropical hardwood and which accounts for 42% of the total world imports of roundwood, 12% of the overall imports of sawnwood and 15% of the global imports of wood-based panels, has an insignificant trading partnership with Brazil. In 1989 only 1.5% of the exported broadleaved sawnwood, less than 2% of the exported veneer sheets and no plywood at all were marketed to Japan. With important hardwood exporters such as Malaysia and Indonesia nearby,

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8. For the exporting sawmills in our survey the principal importing countries are the United States, the Caribbean and the EC countries (Spain and the United Kingdom, in particular).

9. In 1988 the third place was occupied by the United States, which accounted for 9.6% of the Brazilian plywood exports.

imports from Brazil provide little or no profit for Japan because of the high transportation costs involved. Furthermore, Japan mainly imports unprocessed timber whilst the export of logs from Brazil is forbidden by law.

For some decades now, the expectation has been that Amazonian timber will start to play a more prominent part in world trade as a result of the increasing scarcity of African and Asian hardwood. Trade figures do not bear out that this change has yet taken place. Nonetheless, some shifts can be observed with respect to the origin of timber (FAO, 1957, 1965 and 1991).

Africa's share of the total roundwood exports dropped from 35% to 11% over the period between 1960 and 1989. Nigeria has even become a net importer of timber as a result of the depletion of its forests (NIO, 1980). The Philippines, another major hardwood exporter in the 1950s, will probably fare the same. The country saw its market share in roundwood exports falling from 12% in 1950 to 0.3% in 1989. In 1989 the country imported four times the amount of roundwood that it exported. The Philippines share in the world exports of timber products underwent a similar decline over the same period.

However, it was not the Amazon but a number of Asian countries that benefited from the market share which the major exporters of the 1950s had to give up. The Asian market share tripled between 1950 and 1989 and reached levels of 67% of all roundwood exports and 57% of the global exports of sawnwood, whereas the market share for wood-based panels increased from 3% to 40% over the same period. Indonesia in particular, managed to gain a substantial increase in its share of the world exports of sawnwood and wood-based panels during the 1980s by issuing a law that severely restricted the export of roundwood.

The Brazilian share of the international hardwood market has remained only marginal despite its ban on log exports (which had been intended to encourage the export of sawnwood and other timber products) and the depletion of rain forests elsewhere. As a result of the restraints on log exports, they have dropped to almost zero. The share in the total world export of sawnwood initially showed a slight increase from 1.4% in 1950 to 2% in 1975 and eventually to 5% in 1980. But the very same share had dropped back to 3% in 1989. In the same year, the international market

share of Brazilian wood-based panels again reached the 1950 level, after having suffered substantial decreases during the intermediate period.

In the medium term a new gap in the market will open up. It is expected that the forests of Malaysia will be practically logged out within 7-12 years if the current exploitation rate continues (Colchester, 1990). Given the large domestic market and the relatively high exploitation costs in the Amazon, it has yet to be seen if Brazil will be able to fill the gap.

7.3 The International Tropical Timber Organization

The international timber trade has increasingly been the subject of worldwide concern about the disappearance of tropical forests. This has resulted in various efforts being made to encourage forest management and sustainable exploitation practices through interventions in the timber trade. One of the initiatives in this field has been the creation of the International Tropical Timber Organization (ITTO) in 1986. This organization, with its headquarters in Yokahama, Japan, was established to implement the International Tropical Timber Agreement (ITTA), signed in 1983, after six years of negotiations between the major importing and exporting countries. When it came into force in 1985 it involved 36 producer countries and 33 consumer countries of tropical timber (Hpay, 1986).

The original intention of the negotiations was to reach a commodity agreement as had been previously concluded for natural rubber (1979) and jute (1982) within the framework of the UN Integrated Programme for Commodities. These commodity agreements aim at stable prices to be reached by the creation of buffer stocks, higher and less fluctuating export earnings for developing countries and the further processing of timber in the exporting countries (Busink et al., 1982).

However, in the very early stages of the negotiations it became clear that, in the case of tropical timber, attention had also to be focused on sustainable forest management if the ecological and economical importance of the tropical rain forest was to be preserved for the future. This makes the ITTA a unique agreement. For the first time in history an international trade agreement included the goal of environmental sustainability in its economic strategy (Nectoux & Dudley, 1987).

The twofold character of the ITTA - i.e. its balancing between the goals of utilization and the conservation of tropical forests - is reflected in its objectives. In the first place, it aimed to provide a framework for co-

operation and consultation between its members with regard to all aspects of the tropical timber economy. Efforts are directed towards the expansion and diversification of the international timber trade and towards the improvement of market intelligence to ensure greater clarity about the international tropical timber market. Further processing in the producing countries is to be encouraged with a view to promoting their industrialization and to increasing their export earnings.

In the second place, the objectives include the sustainable management and conservation of tropical forests. The ITTO wishes to promote and support research and other activities in the field of sustainable forest management, wood utilization and reforestation. National governments are being encouraged to develop policies aimed at the sustainable utilization and the conservation of tropical forests with their genetic resources and maintaining the ecological balance in the regions concerned (UNCTAD, 1983).

Three permanent committees have been established within the organization in order to realize these objectives: one on economic information and market intelligence, another on reforestation and forest management and a third committee to support and promote the forest industry.

Any country or inter-governmental organization, such as the EC for instance, which is involved in the international timber trade either as a consumer or a producer, may become a member of the ITTO. The number of votes (2000) is equally distributed amongst producing and consuming member countries. The influence which can be exerted by individual member countries is largely determined by the size of their tropical forests and their share of the world timber trade. Most countries have no more than 10-30 votes. Japan, however, which is the major importer, has 330 votes and Malaysia and Indonesia, the major exporters, have 126 and 139 votes, respectively. Brazil, holder of 130 votes, can also count on having a substantial influence, due to its vast area of tropical rain forest.[10]

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10. This distribution of votes has been one of the reasons why some environmental groups doubt as to whether or not the ITTO will be able to achieve its goals. It is argued that the voting structure of the ITTO ensures that the more a country destroys its tropical forests the more votes it gets. As a result, it is felt that the organization primarily represents the interests of the timber trade (Colchester, 1990).

With respect to its objective of encouraging the sustainable utilization and conservation of tropical forests and their genetic resources, in 1990 the ITTO adopted a resolution which stated that all trade in tropical timber was to be supplied from sustainably managed forests by the year 2000 ('Target 2000'). A year later, the member countries signed a more detailed document outlining how this was to be achieved. The member countries committed themselves to reporting annually on the volume of their timber production and the way in which it had been realized. This system should give an indication of the sustainability of logging operations and enable importers to distinguish between countries according to their management practices.[11]

At the end of 1990, the ITTO published its 'guidelines for the sustainable management of natural tropical forests'. These guidelines consist of 41 basic principles and 36 possible actions in the fields of policy and legislation, forest management and socio-economic and financial aspects. They are formulated in general terms and should be specified in accordance with the regional and national circumstances.

One of the guidelines deals with relationships with the local population. It is recommended that provision be made for consulting with local people at an early stage in the planning phase, for a continued exercise of customary rights, for concession agreements and for exploring the extent of assistance, employment, compensation, and other things that should be provided (ITTO, 1990).

It was particularly in respect to this issue that the ITTO has been criticized by environmentalists who believe that the ITTO takes insufficient account of the interests of the indigenous people. A much cited example is the report following an ITTO mission to Sarawak in May 1990 (ITTC, 1990). In this report, the Malaysian government was complimented on the relatively high standard of its policy with respect to forest management and it was believed that, with some adjustments, sustainable forest management can be achieved in Sarawak. Environmentalists challenge this assertion, as they believe that the mission paid scant attention to the grievances of the indigenous population about the activities of the timber companies and the adverse social impacts of logging activities. They also argued that no attention had been paid to the importance of non-timber forest products,

11. A previous proposal for a labelling system for tropical logs which would indicate the sustainability of their sources had been vetoed by Malaysia in 1989.

such as game, nuts and fruits, which are often vital to the lives of the local people (Colchester, 1990).

7.4 Tropical timber boycotts

Some environmental groups question the ITTO's intentions and the effectiveness of achieving a timber trade based on sustainable forest management by the year 2000 and they advocate the immediate suspension of all imports of tropical hardwood from forests which are not managed on a sustainable basis. They consider the amount of money earmarked for the realization of sustainable timber production too small, criticize the failure to state a time-scale for the increase in sustainable timber production and doubt the effectiveness of reporting on volume and origin of the timber production for its non-committed nature ('members are invited to...') (Enthoven, cited in Dorren, 1991).

In addition, there is little confidence among environmentalists that the sustainability of timber exploitation could be controlled by an organization which they regard as being dominated by a small number of Southeast-Asian countries which already see the current logging practices in their forests as 'sustainable' (Colchester, 1990).

Finally, various organizations believe that, by the year 2000, it will be too late for countries whose forests are already being rapidly logged out or felled (Anderson, 1989). In the eyes of the proponents of import bans a further delay in applying trade measures will render them useless as, partly as a result of the unsustainable exploitation of primary forests, no more tropical timber or rain forest will be left within the near future.

In order to curb the negative ecological and social effects of commercial logging in tropical forests, several proposals have been made to restrict the import of tropical timber which is not obtained from sustainably managed forests (Table 7.5). Such boycotts should persuade the timber producers to apply ecologically and socially sound logging methods.

Opponents of trade boycotts, such as the ITTO, hold the view that a boycott implies the loss of the opportunity to exert pressure through trading relationships. In addition, they fear that governments or private owners will give less priority to the protection of tropical rain forests when confronted with falling export revenues from timber products, or that the conversion of forest to other forms of land-use will be encouraged in order to compensate for the loss of profits (Hamilton, 1991).

There are even more reasons to doubt the effectiveness of a timber boycott in Brazil. In the first part of this chapter, we have seen that timber exports contribute little to the Brazilian balance of payments and that the domestic market is large enough to offer an alternative outlet for the products.

In Chapter 4 we showed that logging in the Amazon is closely linked with making clearings for agriculture and cattle-ranching. The cheap supply of logs from these clearings makes investing in forest management for the sustainable production of timber not viable economically for the time being.

We have also seen that there is a myriad of roundwood sources and supply methods, with a large number of intermediaries involved. This makes effective control of the origin of raw material virtually impossible. This is particularly true of the IBAMA which, despite the apparent commitment of the Collor Administration to the conservation of the Amazon forest still labours under financial and technical conditions too poor to ensure that proper supervision and other tasks are carried out (see Chapter 5).

There is also the problem of corruption. We heard several timber producers say that they were not concerned about a ban on non-sustainably produced timber because 'here in Brazil you can buy any paper you want. If they want a certificate, they can have it.' Indeed, it was proved by a former auditor of IBAMA that this institute issued irregular licenses to cut down the rain forest, including protected indigenous areas (Brazil Report, 92-04).

Next, there is the point of whether sawmill owners are willing and able to apply more responsible logging methods. Criteria for sustainable forest management are not yet clearly defined and for the great majority of sawmills, the profit-margin is too small either to actually undertake ecologically sound logging operations or to buy a document certifying that they have done so. Under the present circumstances, only the largest companies would be able to operate on the world market when forced to produce under sustainable management plans.

For most of the large sawmills in our survey a boycott of unsustainably produced timber would have no effect as they already have a management plan, at least on paper. Only two of the seventeen large enterprises would be confronted with problems if import restraints were to be applied. Two other large mills would stop exporting and re-orient towards the national

Table 7.5 Selected examples of calls for import restraints for tropical timber

Year	Country - Action
1987.	United Kingdom - Friends of the Earth cautions consumers to avoid tropical hardwoods.
1988.	United Kingdom - 200 retailers and timber-users adopt policies of using only sustainably produced wood.
1988.	Federal Republic of Germany - 200 city councils stop using tropical timber.
1988.	European Parliament - Announcement that all member states will ban imports of Sarawak timber (later rejected by the European Commission).
1989.	Federal Republic of Germany - The Minister for Building announces that the government has stopped using tropical timber.
1989.	Federal Republic of Germany - The Timber Importers Federation introduces a code of conduct for timber importers.
1989.	European Federation of Tropical Trade Associations proposes a levy on tropical timber imports to the European Community.
1989.	Australia - The Federal Government considers banning imports of rain-forest timbers (no decision taken).
1989.	The Netherlands - Nearly one-half of all local governments stop using tropical timbers.
1989.	Japan - In a speech made at the Osaka Royal Hotel, former United States President Ronald Reagan raises the possibility of a boycott of Japanese products, mentioning tropical logging.
1989.	Japan - Malaysia vetoes the ITTO proposal to label tropical logs according to the sustainability of their source.
1990.	United Kingdom - Prince Charles calls for a boycott of tropical hardwoods from unsustainable sources.
1990.	United States - Draft bill introduced in Massachussets Congress to prohibit state purchases of tropical timber.
1990.	United States - Rainforest Action Network calls for ban on tropical timber imports and wood uses.
1990.	United States - Sierra Club begins development of a policy for a selective country boycott of tropical woods.
1990.	United States - Rainforest Alliance publishes consumer guide for use of tropical woods, emphasizing use of plantation-grown resources.
1990.	United Kingdom - Ecological Trading Company attempts to identify and certify 'sustainably produced tropical hardwoods'.
1990.	United States - State of Arizona bans use of tropical timber in public construction. Similar bans under consideration by several United States cities, including Bellingham, San Francisco and Baltimore.
1990.	European Parliament passes Resolution banning tropical forest products. ASEAN economic ministers declare strong opposition.

Source: Goodland et al. (1990) and Hamilton (1991).

market. For none of them would a boycott result in a change of management or logging practices. Neither is this to be expected from the 19 medium-sized and small sawmills which produce - directly or indirectly - for the world market. None of the owners of these sawmills interviewed intended to change over to the required management practices in the case of a timber boycott. Four of them would give up exporting because their profit margins would not allow for investments in forest management. Three sawmill owners expected serious financial problems if a ban were operated and six of them predicted bankruptcy if effective import restraints were applied.

A boycott of non-sustainably produced timber would also jeopardize the viability of the many small sawmills which are unable to export directly and currently sell their products to large companies that operate on the world market. These indirect exporters, who generally work with timber from clearings, would disappear if exporting companies had to prove that all of their timber came from sustainable operations. For the same reason, fewer lumbermen would be needed. All this implies that a boycott of Amazonian timber would have a number of adverse social consequences.

The the timber industry's suggestion that these negative effects can be partly obviated by raising the level of timber prices or by charging for the ecological damage only makes sense if an independent institution to manage the additional financial means in the interest of the tropical rain forest and the local people functions adequately. Higher prices alone are not a sufficient motivation for the individual entrepreneur to implement sound logging practices. Higher prices simply mean higher profits which, in the Amazon, are usually invested in landownership and in the conversion of forest into pasture. Furthermore, higher profits attract more timber companies, of which the town of Paragominas in eastern Pará provides an example. After some pioneers had made a fortune in timber exploitation, the number of sawmills in the village increased from three to three hundred between 1979 and 1989.

The main reason why a boycott of unsustainably produced tropical hardwoods would have little effect on the deforestation figures in the Amazon, however, is the fact that the unbridled expansion of agricultural activities is a much more decisive factor in the destruction of the Amazonian rain forest than is timber extraction. The background of this expansion is not primarily to be found at international level, but is rooted in the Brazilian economy and society. The unequal distribution of land

ownership and the amalgamation of small family farms into large agricultural enterprises in the northeastern and southern parts of the country especially, provokes a flow of landless peasants and smallholders in search of land and a better life in the Amazon (Browder, 1988).

The dramatic level of inflation, which seems to have become a structural element in the Brazilian economy, makes it attractive to invest in land and cattle to secure one's profits. Until recently, the establishment of large cattle ranches was also encouraged by tax incentives conceded by the Brazilian government to entrepreneurs who invested in the Amazon region.

The Brazilian Land Statute is another incentive to excessive deforestation. This law allows the public sector to expropriate unproductive land for the purpose of agrarian reform. One way for the landowner to 'prove' that his land is effectively used and, as such, is not subject to expropriation by the government, is to burn down parts of the forest on it (Nascimento & Kengen, 1988). The more land is cleared, the more land can be claimed. According to Hecht (1989), an area six times the size of the actual land cleared can be claimed as one's property. Clearing land for property and selling it for huge profits has become a commercial undertaking in itself. The authorities hardly combat land speculation at all.

All this is not to say that international aspects play no role in the deforestation of the Amazonian rain forest. The magnitude of Brazil's foreign debt and the burden of interest rates encourage the Brazilian government to continue opening up the Amazon region and exploiting its natural resources for export. Examples are mega-projects such as Jarí (wood-pulp and paper), Carajás (iron ore) and the Tucuruí hydroelectric project, which provides energy, mainly for the export oriented aluminium industry.

The export-oriented policy is also an indirect threat to the Amazon because the expansion of coffee and soya bean plantations in southern Brazil is displacing small farmers and rural workers, who move to the Amazon to clear new forest areas (Browder, 1988).

Finally, it has been through the financial support of the international financing agencies such as the World Bank that roads were constructed and improved and large development projects, with their negative ecological consequences, were implemented.

7.5 Summary

In this chapter we have analysed the market for Amazonian hardwood, in order to assess the possible impact of trade measures on the logging practices of the timber industry. We have seen that Brazil has only a minimum share (2.5%) of the international tropical hardwood trade and that Amazonian wood species contribute only a mere 0.7% to the total foreign trade of the country. The domestic market offers ample opportunities for the outlet of the industry's output. Hence, in the case of Brazil the opportunities for exerting pressure through trade intervention is very limited.

We described two initiatives which have as their intention the promotion of sustainable forest management via the international timber trade: the International Tropical Timber Organization (ITTO) and the call for import bans for tropical timber which is not exploited on a sustainable basis.

The two initiatives described present two widely diverging strategies. The ITTO intends providing a framework for mutual co-operation between timber producing and timber consuming countries, in which the tropical hardwood trade plays a crucial role. It presents an important political force on a global scale for representing the great majority of both timber exporting and timber importing countries. As such, it offers a strong potential for promoting the development of the timber trade on a sustainable basis.

The advocates of import boycotts, on the other hand, consider the timber trade, the ITTO included, to be a threat to the tropical forest and its population. Their role is more significant in mobilizing public opinion on the need to conserve tropical forests and to protect the indigenous and other local people. Unhindered by any interest in the international tropical timber trade, they may feel free to suggest more radical measures than the ITTO.

It is unlikely, however, that import restraints will result in a change of management and logging practices in the Brazilian Amazon. The national market is large enough to offer an alternative outlet for boycotted timber products. Even the owners of the sawmills in our survey, who sell a larger part of their production abroad than the Amazonian timber industry as a whole, do not expect to change over to other methods for obtaining roundwood if an import ban was imposed on their products.

Import bans are likely to favour large companies which already fulfil the requirements for sustainable forest management or have a profit margin

which is large enough to do so. The position of medium-sized and small sawmills would be jeopardized because of being unable to meet the required conditions and for losing the opportunity to export indirectly if the large companies had to prove the origin of their roundwood. Other obstacles to sustainable forest exploitation which are not easily to overcome are the features of roundwood supply methods, the link between logging and agriculture, the small profit margin for the majority of the sawmills, and the weakness of the Brazilian forest service IBAMA.

It is also unlikely that trade measures would be able to halt or even influence the rate of deforestation in the Brazilian Amazon, as the principal force behind the destruction of the forest is not commercial logging but the expansion of pasture and farming land. Measures to prevent the further conversion of forest into agricultural land, however, should basically be found outside the timber economy and, partly, even outside the Amazon region. These measures require radical changes in the socio-economic and agricultural policies of the Brazilian government whereby possible intervention in the current distribution of landownership should not be ruled out.

8 Summary and conclusions

This study has aimed at providing a description of the spatial and socio-economic features of the timber industry in the Brazilian Amazon and at analysing the social, economic and ecological effects of timber exploitation. In this effort, our intention was to find an answer to the question of what it is that logging and wood processing contribute to the sustainable development of the Amazon region.

This central question was split into four research questions:

1. What forms of timber exploitation can be found in the Amazon region, what are their spatial and socio-economic features and how have they been influenced by planned and spontaneous processes?
2. What forms of roundwood supplies exist in the Brazilian Amazon, what are the ecological effects of logging operations and what are the prospects for sustainable forest management?
3. In what way does the timber sector contribute to the socio-economic development of the Amazon Region and to its incorporation into the national and international economy?
4. How is the development of the Amazonian timber sector related to the national and international market for tropical hardwood and what is the possible effect of trade restrictions concerning timber from forests which are not managed on a sustainable basis?

After a recapitulation of the research methods, we will then summarize and discuss below the main findings of our study.

8.1 Design and implementation of the study

The study was carried out in the region of Santarém in the western part of the state of Pará. This region covers an area of around 30,000 km^2 in the municipalities of Santarém, Rurópolis and Uruará, south of the Amazon river and north of the Transamazônica. The main reason for selecting this area was that although Santarém is one of the older wood-processing centres of the Amazon region, many new sawmills have been established as a result of the opening up of the region. This offered an opportunity to study both traditional forms of timber exploitation and those which are the result of the recent colonization process.

In 1989, the sawmills in this region numbered around 60, and, aside from the city of Santarém all were located along the three major roads that intersect the region (the Transamazônica, the road from Santarém to Cuiabá and the Santarém-Curua Una road).

All the sawmills in the area were visited for an interview which provided data on locational aspects, the sources of roundwood and log supply methods, the employment created, the recruitment of the workers, production, equipment, the destination of the products, relationships with government institutions and the economic aspects of wood processing. As very large companies were virtually absent from our study area, we also included 11 large timber companies from Belém in our survey.

To acquire more information about the working conditions and the features of the labour force, a questionnaire was put to a total of 60 workers. Finally, open interviews were conducted with nine autonomous lumbermen engaged in the logging, transportation and selling of roundwood. Representatives of social organizations such as trade unions, environmental groups and other grass-roots organizations were interviewed to obtain more data on the social consequences of timber exploitation.

A final stage in the fieldwork was the observation of various logging operations on distinct scales and technological levels. Observations focused on the number of workers, the organization and division of the work, the productivity, the damage to the vegetation, the provision of food and shelter for the loggers and the risks of labour accidents.

While elaborating the data, we also used studies previously made in other parts of the Amazon region in order to compare our findings. Additional and background information was also collected in the form of governmental reports, unpublished research reports and theses in Brazil, statistical publications, documents of non- governmental organizations and newspaper articles.

8.2 Background and features of timber exploitation in the Amazon

The first research question concerning the different forms and the features of timber exploitation and the spontaneous and directed developments that influenced the growth of the timber industry was developed in the Chapters 2, 3 and 4.

In Chapter 2 the growth of the Amazonian timber industry was placed against the background of planned and spontaneous developments at

national level. We have seen that the wood-processing industry was traditionally located in other parts of Brazil near pine forests with high-grade Parana pine (*Araucaria angustifolia*) particularly in the more developed southern part of the country. As a result of the depletion of these forests, raw material became increasingly scarce and alternative sources of roundwood had to be found.

The Amazon became an option for relocation as the result of the strict government policy of the 1960s and 1970s in opening up and developing the region. Several roads were constructed which opened up hitherto inaccessible timber stocks and provided connections between the sources of tropical roundwood in northern Brazil and the consumers and wood-processing industries elsewhere in the country. Labour, which had always been scarce in the Amazon, became available through directed and spontaneous migration. Large areas of land could be acquired cheaply and large companies could benefit from fiscal incentives when investing in the Amazon region. Clearings for agriculture and cattle-ranching resulted in a steady increase in cheap roundwood supplies in the colonization areas.

Specific efforts to develop the timber industry have been less successful. However, as a result of more research into the Amazonian timber resources, more insight was gained in the stocks of commercial timber and the characteristics and the utility of previously unknown wood species.

In Chapter 3 we described the features of the Amazonian timber industry. Many of these features are related to the process of opening up and colonizing, described above. Traditionally, timber extraction took place in areas accessible by river and wood processing was concentrated in the cities of Belém, Manáus and, to a lesser extent, Santarém. With the construction of some major roads and the clearing of large tracts of forest, timber exploitation shifted away from the main urban centres to the colonization areas. The core of logging and wood-processing activities can now be found along the roads constructed during the past decades, in recently occupied areas such as eastern and southern Pará, the northern part of the Mato Grosso and the entire state of Rondônia. Most sawmill owners come from other parts of Brazil, principally from the South but also from the Northeast.

The Amazonian timber industry comprises of thousands of predominantly small sawmills scattered all over the region. It is the small sawmills in the rural areas which are closely linked with the colonization

process. In general they are recently established and will be dismantled within a couple of years. They often function alongside agriculture, taking advantage of the supply of trees which are felled when bringing land under cultivation which is owned by the sawmill owner or by peasants in the neighbourhood. Wood processing seldom goes beyond the production of plain sawnwood. Equipment is poor and often obsolete. In the rainy season production is halted as roads become impassable and no capital is available in order to stockpile logs. Production volume seldom exceeds 500 m^3 per year.

The small sawmills located in the city of Santarém also process timber from areas to be cleared for agriculture. In these cases, the logs are supplied by third parties, autonomous lumbermen who, in Brazil, are referred to as *madeireiros* or *toreiros*. Altogether, more than two thirds of the sawmills in our study area belonged to the category of small sawmills. Their joint production, however, amounted to no more than 16% of the total timber production in the Santarém region.

Aside from some medium-sized sawmills in the rural areas, the large sawmills which had been primarily set up as wood-processing industries were to be found in the cities. The products of these sawmills undergo further processing and are qualitatively better. Though the output volumes of the larger sawmills are still considered to be low, they are a great deal higher than those of the small production units. Medium-sized sawmills produce, on average, around 1,000 m^3 per year whereas the mean annual production of large sawmills amounts to upwards of 3,400 m^3. In our study area, 22% of the enterprises belonged to medium-sized sawmills with a production between 500 and 2,500 m^3 per year. A mere 7% of the enterprised were 'large' sawmills, which produced between 2,500 and 5,000 m^3 per year. The share of these categories in the total production in the Santarém region amounted to 27% and 29%, respectively.

A fourth category of enterprise is constituted by the large wood-processing companies. These companies show little resemblance to the smaller enterprises either in respect to their products (parquet, veneer, plywood), or in respect to their production level (more than 5,000 m^3 per year). Although these companies form a minority, their influence is much stronger than the others due to the larger scale on which they operate. The large companies absorb part of the production of the small sawmills which attempts to find a way to external markets. In our study area only one company belonged to the category of 'very large' enterprises. But this

enterprise alone accounted for a quarter of the total production of the Santarém region.

In Chapter 4 we analysed how the sawmills are supplied with roundwood. We concluded that only a limited number of timber species are utilized, mahogany (*Swietenia macrophylla*) and virola (*Virola* spp.) being the principal species for the Amazon region as a whole. We described several forms of timber extraction, differing in scale and technological level. The distinction between the seasonally flooded *várzea* forests and dry upland forests (*terra firme*) turned out to be decisive with respect to the organization of the logging process, the equipment used and the way the logs are transported.

In the *várzea* forests, which are generally public domain, only accessible by river and hence more difficult to reach, traditional logging methods prevail. Much of the work is done by hand and the logs are transported by water in the form of rafts or by barge. The loggers work autonomously but receive food and material in advance from the buyer. Labour relations between the logger and the buyer, who could be an intermediary or a sawmill, closely resembles the traditional debt relation between the rubber tapper and the rubber merchant - a system known as *aviamento*. The companies surveyed in Belém obtained 48% of their raw material from lumbermen working in *várzea* forests.

Terra firme forests are logged where they are accessible by road. In general, these forest tracts are privately owned by the colonists, though some exploitation also takes place in the more isolated parts which are public domain. Heavy machines can be used in the *terra firme* forests. Whether they are actually used or not depends on the actor involved in the logging operation. We have seen that many sawmills do not undertake the logging themselves but buy the logs from autonomous lumbermen. These lumbermen operate on a small scale with a chain-saw, a machete and a truck equipped with a winch to load the logs. This method of working was also found amongst the small sawmills in the colonization areas. The trees are then felled in tracts of forests which peasants - often the lumberman or the sawmill owner himself - intend to clear for fields. Twenty three per cent of the surveyed sawmills worked in this manner.

The medium-sized sawmills undertaking their own logging operations work on a slightly larger scale because they generally employ one extra machine in addition to the chain-saw and the logging truck. In the colonization areas, where farming and logging are closely associated a

tractor is often used. Sawmills working at this intermediate level in the city more often use a bulldozer or a front-end loader. Twenty-one per cent of the surveyed sawmills logged on this intermediate level.

In the case of large-scale mechanized operations, the full range of machinery (bulldozers, front-end loaders and skidders) is used. At this level, the division of labour between the workers is strictly organized. Only a few large companies (14% of the surveyed enterprises) worked on this scale. These operations partly involve virgin forest. But large-scale exploitation, too, is closely associated with clearings through logging contracts between timber companies and large landholders who intend to convert forest to pasture.

More than two fifths (42%) of the surveyed sawmills entirely depended on third parties for their log supply. The sawmills employing their own logging teams also obtained part of their raw material from intermediaries. In total, 80% of the roundwood utilized by the surveyed sawmills came from lumbermen not directly employed by them.

Our conclusions with respect to the first research question can be summarized as follows:

- During the past 30 years a new form of timber exploitation has developed in the Brazilian Amazon in close association with the colonization of the region and the clearings for agriculture and cattle-ranching. This has resulted in a sharp increase in the number of predominantly small sawmills in areas which have been opened up and brought under cultivation.
- In addition, the opening up of new timber stocks has attracted large companies from southern Brazil where raw material has become increasingly scarce. To a limited extent, the relocation of these companies has been influenced by tax incentives which large companies could obtain when investing in the Amazon region. These large companies are generally located in the cities.
- Small-scale logging prevails in the extraction process, where autonomous lumbermen play a cardinal role. In these small-scale operations there is still a place for traditional forms of timber exploitation and the labour relations associated with them.
- The relationship between the sawmill and its source of roundwood is often indirect: the sawmills either do not undertake the logging

themselves or they log forest areas owned by others. Both situations are little conducive to applying sustainable logging methods.

8.3 Ecological effects and the prospects for sustainable forest management

The second research question, which refers to the ecological effects of logging operations and prospects for the application of sustainable logging methods, was dealt with in Chapter 5. A review of the literature on logging damage caused by uncontrolled mechanized operations showed that harvesting only a small percentage of the trees per hectare, results in the destruction of or irreversible damage to up to a quarter or even a half of the remaining trees. In addition, mechanized logging results in the decreasing diversity of tree species and wildlife, to the depletion of genetic resources, to soil erosion and compaction and to an increasing susceptibility to forest fires.

Selective logging without the use of heavy machines results in considerably less damage. Whereas in this instance too logging may result in an increasing scarcity in the most valuable timber species, the damage to the remaining forest is considerably lower (around 10%) and no impact can be perceived on wildlife.

We estimated that, in the Amazon around 10,000 km^2 are logged each year. However, as small-scale operations prevail and wood extraction is closely associated with clearings for agriculture and cattle-raising, commercial logging cannot be considered to be one of the major causes of deforestation in the Brazilian Amazon. These causes are primarily to be found in the establishment of large cattle ranches, clearings for small-scale farming, the construction of roads and hydroelectric dams and large-scale mining projects.

As it is to be expected that large-scale operations will be of growing importance in the near future, the development of sustainable logging methods is of great importance. On the basis of a survey of the literature we can conclude that forest management for the sustainable production of timber is currently feasible from a technical point of view, although further research is needed to adapt existing systems to the specific conditions of the Amazon.

More important than technical feasibility are the socio-economic and political conditions under which sustainable forest management needs to

take shape. A review of the key elements for successful forest management showed that, in the Brazilian Amazon the basic conditions for sustainable timber exploitation are absent. The lack of sound forest and land-use planning, a strong forestry service and the political will to preserve the forest as an ecosystem for the future, are particularly serious obstacles to the sustainable management of the Amazonian rain forest. Consequently, a land-use pattern has developed during the past 30 years which is highly destructive to the forest and the people who depend on it for their livelihood.

To sum up, the following can be concluded with respect to the ecological effects and the prospects for sustainable forest use:

- Timber exploitation is not one of the major causes of deforestation in the Brazilian Amazon, in part because small-scale logging operations are the most prevalent and also because of the close connection between timber exploitation and clearing for agriculture and cattle raising.
- In the Brazilian Amazon, timber exploitation does mot lead to the opening up of hitherto closed forest areas for subsequent settlers to the same extent as in other rain forest areas. This can be explained by the fact that timber exploitation is more a consequence of than a cause of clearings.
- Although forest management for the sustainable production of timber is technically feasible it is severely hampered in the Brazilian Amazon by the indirect (ownership) relationship between sawmills and the timber source, the cheap supply of logs from clearings and by the general political and institutional context.

8.4 Socio-economic aspects

In Chapter 6 we analysed the socio-economic importance of the timber industry. We thereby highlighted four different aspects. The first referred to the degree to which the timber industry contributes to satisfying the basic needs of the local people. Next, we considered the timber industry as a source of employment and income. Subsequently, we studied the conflicts between timber companies and local people, distinguishing between conflicts with inland communities over the exploitation of forests in their neighbourhood, conflicts over logging in indigenous areas and land conflicts. We concluded the chapter with a presentation of the opinion of

various local social organizations on the role that the timber industry could play in the development of the region.

With respect to the socio-economic effects of the timber industry, it emerged from Chapter 6 that it is important to make a distinction between the small sawmills on the one hand and the large timber companies on the other. The small sawmills which are higher in number, but play a minor role in the total production volume are much more integrated into the local economy. Their production of construction timber and timber for boats and agricultural tools is oriented towards local consumers. The larger part of the raw material they utilize comes from clearings so that damage to the primary forest and wildlife is minimal. Wood processing in colonization areas provides an additional source of income for small peasants who can barely survive on farming alone. The sale of trees or sawnwood also supplements the agricultural activities of these small producers.

Medium-sized and large enterprises play a more important role as a source of employment. Large companies also create employment for women, especially in the manufacture of veneer, plywood and parquet. Employment in the large companies is also more stable than in the small and medium-sized sawmills as they are less susceptible to seasonal variations in the supply of roundwood.

The profits of medium-sized and large sawmills are generally reinvested within the region, both in the timber industry and in other economic activities. In this sense these enterprises contribute significantly to the diversification of the regional economy.

In other respects the presence of large companies is considerably less positive. Uncontrolled mechanized logging operations result in the reduction of wildlife which is a source of protein for the local people in the interior. Moreover, the production of these companies is mainly oriented towards markets in southern Brazil and abroad. As a result of the higher profit margins that can be realized elsewhere, high quality hardwoods are now too expensive for the local people.

The large sawmills and wood-processing companies also constitute a source of conflict in several respects. The inland population (*caboclos*) increasingly protest against the presence of large timber companies as the activities of these companies conflict with their means of subsistence (hunting, shifting cultivation and the extraction of non-timber forest products, such as fruits, nuts and latex). The various ways in which timber companies legally and illegally extract timber from indigenous reserves also

constitute a threat to the livelihood and cultural identity of the indigenous people. A third group of conflicts are those concerning disputed land titles. Timber companies, which are primarily interested in timber resources, generally play an indirect role in land conflicts through paying land squatters (*posseiros*) in exchange for the felling of trees. Several timber companies with large forest areas are, however, also directly involved in conflicts about land. This is often the case when they take possession of a forest area which was already being used by people from the inland communities or where peasants were already established. Land conflicts also arise when small farmers settle in the forest area that is appropriated by a timber company but not clearly utilized productively.

A problem irrespective of the scale of operations is the frequent occurrence of accidents at work and the disregard of accident prevention measures.

The local population, represented by their social organizations, has never been involved in decisions concerning the establishment and development of the timber industry. We discussed two examples which showed that organizations which represent the local population have clear ideas on the role that the timber industry can play in the development of the region. The proposals presented showed that these organizations are certainly not against the presence of wood-processing industries in the region, provided that (1) timber exploitation fits within a broader framework of land-use planning and forestry policy, (2) logging takes place on a sustainable basis and is strictly controlled, (3) indigenous areas are effectively protected, (4) production is primarily oriented towards local needs, and (5) workers can be certain of good labour conditions and of participation in the management of the enterprise.

To sum up the following are our conclusions with respect to the socio-economic importance of the Amazonian timber industry:

- The timber industry can play a significant role in the socio-economic development of the Amazon region. There is a growing need for timber products and for employment. Moreover, logging and wood processing can subsidize and supplement agricultural activities and may lead to additional investments in other branches.
- In its current context, the timber industry does not play this role effectively as a result of a lack of control over the behaviour of large companies, in particular. This control applies both to logging operations

and to labour conditions. In this respect, the lack of proper land-use planning is also relevant. Its absence leads to the inadequate protection of indigenous and other local people against the illegal or exploitative extraction of wood resources and results in land disputes and conflicts over forest use.

8.5 The timber industry in international perspective

The fourth and last research question referred to the performance of the Amazonian timber industry on the national and international market for tropical hardwood and the possible impact of trade measures on the sustainability of commercial logging. This question was the subject of Chapter 7. We saw that approximately 90% of the total Amazonian timber production is sold on domestic markets. In addition to the Amazon region, the principal markets are to be found in the populous Northeast and Southeast of Brazil.

Foreign markets are more important for the sawmills surveyed than for the Amazonian timber industry as a whole. We found that the location of the markets, the categories of buyers and the utilized marketing channels differ with the output volumes of the enterprises. When an enterprise produces a larger quantity the local markets and private consumers become accordingly less significant as outlet for the production, whilst commercial timber consumers (wholesale, wood-processing industries and construction companies) and the export market become more important.

Hardwood from the Amazon contributes with a mere 0.7% to the total value of Brazilian exports. Amazonian hardwood plays a role of little account in the international timber trade. Only a limited number of species, such as mahogany (*Swietenia macrophylla*) and virola (*Virola* spp.) find easy acceptance. The principal countries which import from Brazil are the United States, the United Kingdom, Spain, Italy and some of the Caribbean islands. Japan, the world's number one importer of tropical hardwood, has no significance at all as an outlet for timber from the Amazon. As yet no effect is perceivable in terms of a larger share the world trade as a result of the depletion of forests in Africa and Southeast Asia.

The ample sales potential within the country, the little significance of hardwood exports for the Brazilian trade balance and the marginal role of Amazonian hardwood on the global market, make it difficult to exert pressure on timber companies to change existing logging practices. In

Chapter 7 we described two - partly contrasting - initiatives in this field: the International Tropical Timber Organization (ITTO) and the campaigns to restrict the imports of timber from forests not managed on a sustainable basis.

We concluded that interventions via the timber trade will probably have little effect on logging practices or on the deforestation of the Brazilian Amazon. This can partly be attributed to the features of timber exploitation itself: log supplies through intermediaries, the relationship between commercial logging and clearing for agriculture and too narrow profit margins for the small sawmills to exploit the forest on a sustainable basis. It is also in part caused by the ill-functioning of the Brazilian forestry service, the IBAMA, which is responsible for the supervision of timber companies. Finally, we pointed out that the principal causes of deforestation in the Brazilian Amazon are to be found outside the timber industry, in farming and cattle ranching, large scale mining projects and the construction of hydroelectric dams.

With respect to the trade and the effect of trade measures we concluded that:

- The domestic market is more significant for the timber industry in the Brazilian Amazon than are foreign markets. Amazon timber also contributes little to Brazilian export revenue and has a small share in the global timber trade. These factors combined make the timber industry very little sensitive to any pressures exerted through the trade to exploit the forest in a sustainable manner.
- The effect of trade measures on logging practices in the Brazilian Amazon will be limited for the time being. This can be explained to a great extent by the features of current forest exploitation. Forest management is impossible or unattractive if (1) tracts of forest are exploited which are owned by someone else, (2) a tract of forest is logged which is to be cleared for agricultural activities, (3) logs are supplied by intermediaries, (4) commercial logging is undertaken as an additional economic activity and/or (5) logging and wood processing yield profits too small to invest in sustainable forest exploitation.
- Trade measures will produce little effect on the deforestation of the Amazon because commercial logging is not one of the primary causes of forest loss in Amazonia.

8.6 The timber industry and the sustainable development of the Amazon region

The central question to be answered in this study was about the possible contribution of the timber industry to the sustainable development of the Amazon region. As the answer to this question is closely related to what is understood by 'development' we have defined the concept of development in Chapter 1 as a process which implies (1) the increasing availability of basic goods and services for an increasing number of people, (2) the reduction of severe disparities in income and/or access to land and other resources, (3) the increasing capacity of the poor to control and act upon the development process of which they form part and (4) the maintenance of the capacity of the earth to meet basic needs in the future.

Reviewing the aforementioned conclusions we have to conclude that the timber industry in the Brazilian Amazon region contributes to the sustainable development of the region only to a limited extent. Only the smallest sawmills are oriented towards local timber needs. The larger enterprises produce primarily for consumers elsewhere in Brazil and abroad. As a result, high-grade timber has become too expensive for the majority of the Amazonian population. In addition, large scale logging operations, in particular, negatively influence wildlife at the cost of the people who depend on game for their meat consumption.

The timber industry is an important source of employment and timber exploitation in many instances means an additional source of income for small-scale peasants. Profits are generally reinvested within the Amazon region. This does not imply, however, that the timber industry contributes to a reduction in the severe disparities in income or access to natural resources. Wages are low and the profits of large sawmills and timber companies benefit only a small group of entrepreneurs. Bad working conditions result in a large number of labour accidents. The activities of the large companies, in particular, constitute a threat to indigenous and other people who depend on the forest for their subsistence. The large companies especially are often involved in conflicts over land and landless and small peasants often the losers.

The development of the timber industry has not resulted in an increasing capacity of the poor to influence the development process. Policy makers and entrepreneurs seldom consider the opinion of social organizations. Their plans for stimulating Amazonian forestry or investing

in the timber industry have often been developed outside the Amazon region without consulting local people.

As it now stands, timber exploitation in Amazonia is not sustainable. Investments in forest management to maintain the production capacity of the forest for the future are rare. These investments have no sense in the case of trees being used which would otherwise be felled in any event to make way for cropland or pasture. But even when the forest is primarily exploited for timber, actions which could provide for the regeneration of the forest are rarely taken.

There are certainly opportunities for increasing the timber industry's contribution to regional development. But it is drastic measures which are needed to ensure that this development will benefit local people and that it is sustainable in character. In this context, the following aspects should be considered:

1. Sustainable timber exploitation can only be realized if it has a place in a sound planning of land and forest use. In addition to allocating land for timber exploitation, it is important that such planning sets aside forest areas for the purpose of conservation and for the exploitation of non-timber forest products. Indigenous areas need to be effectively demarcated and protected. There also has to be protection from illegal logging operations and timber negotiations on unfavourable terms to the indians. Moreover, it is to be recommended that land-use planning considers claims for non-forest land uses such as farming and mining. It is important to plan these land uses in such a way that they take place in those parts of the Amazon which are the most suitable for them on the basis of their soil fertility or other natural conditions.
2. When designing land-use planning as mentioned above it must not be forgotten that the Amazon region is not an 'empty space'. As a result of the lack of such planning when the Amazon was opened up, a wide range of social groups and land uses have already come into existence and often conflict with each other. To prevent further escalation of these conflicts it is necessary to involve the population groups affected in the planning process. The situation as it has developed also requires strict policies to solve the conflicts that have arisen.
3. Sustainable timber exploitation and sustainable development of Amazonia in general also requires measures to be taken outside the Amazon region. It should not be that social problems elsewhere in

Brazil can result in the migration of landless peasants and the displacement of social problems to the Amazon region. This requires a strong national, agricultural policy that brings an end to extreme disparities in land tenure and provides more support to small peasants.

4. When designing a policy specifically oriented towards the timber industry, it is advisable to take account of the considerable differences between the majority of small sawmills on the one hand and the large companies on the other. Small sawmills can play an important role in the regional economy as they are oriented towards local needs for timber, utilizing trees from clearings and broadening the base of subsistence for small farmers. Large companies must be checked more strictly regarding illegal logging, involvement in land conflicts and their obligation to sustainable forest management.
5. In order to reduce the large number of labour accidents in the timber industry, it is desirable that pay more attention be paid to the prevention of these accidents. This requires better working conditions, better instructions about the careful use of machinery and the use of protective clothing.
6. The Amazon region needs a strong and well organized forestry service with sufficient manpower, material and financial means to perform its monitoring task properly.
7. More rigorous controls and more severe punishments are needed to combat illegal logging in preservation areas and in indigenous reserves.
8. Research into sustainable logging methods which are adaptable to the conditions of the Amazon region deserve more support. In addition, it would be wise to put more resources into the publication and dissemination of the results of this kind of research amongst policy makers and entrepreneurs in the timber industry.
9. Finally, initiatives which are oriented towards conserving and/or utilizing the forest in a sustainable way should be stimulated, e.g. by fiscal or other financial incentives for activities that will lead to the maintenance, protection and responsible management of the forest.

Appendix 1

List of Brazilian institutions and organizations visited in 1988/89

Rio de Janeiro
- Campanha Nacional de Defesa e pelo Desenvolvimento da Amazônia (CNDDA)
- Carteira do Exterior (CACEX)
- Fundação Brasileira para a Conservação da Natureza (FBCN)
- Instituto Brasileiro de Análise Social-Econômico (IBASE)
- Instituto Brasileiro de Geografia e Estatísticas (IBGE)
- Universidade Federal do Rio de Janeiro (Departamento de Geografia)

São Paulo / São José dos Campos
- Centro Brasileiro de Pesquisas Económicas (CEBRAP)
- Instituto Nacional de Pesquisas Espaciais (INPE)
- Instituto Florestal de São Paulo / Instituto de Pesquisas Técnicas (IPT)

Belo Horizonte
- Centro de Desenvolvimento e Planejamento Regional (CEDEPLAR)

Brasília
- *Conselho Indigenista Missionário (CIMI)*
- Empresa Brasileira de Assistência Técnica e Extensão Rural (EMBRATER)
- Food and Agricultural Organization / United Nations Development Plan (FAO/UNDP)
- Instituto Brasileiro de Planejamento Econômico e Social (IPEA)
- Instituto Brasileiro de Desenvolvimento Florestal (IBDF)
  . Departamento de Economia Florestal
  . Divisão de Manejo Florestal
- Instituto Nacional de Estudos Económicos (INESC)
- Ministério da Agricultura / Coordenadoria de Programas Especiais

Belém
- Banco da Amazônia (BASA)
- Comissão Pastoral da Terra (CPT)
- Empresa Brasileira de Pesquisas Agrárias (EMBRAPA) / Centro de Pesquisas do Trópico Úmido (CEPATU) / Departamento de Pesquisas Florestais
- Federação das Indústrias do Estado do Pará (FIEPA)
- Federação dos Orgãos para a Assistência Social (FASE)
- Instituto Brasileiro de Desenvolvimento Florestal (IBDF)
- Instituto do Desenvolvimento Econômico do Estado do Pará (IDESP)
- Museu Goeldi / Departamento Botânico
- Superintendência do Desenvolvimento da Amazônia (SUDAM)
  . Departamento de Recursos Naturais
  . Departamento de Recursos Humanos
  . Centro de Sensoramento Remoto da Amazônia
- Universidade Federal do Pará
  . Núcleo dos Altos Estudos Amazônicos (NAEA)

Paragominas
- Ministério de Reforma Agrária e Desenvolvimento Rural (MIRAD)
- Secretaria da Terra
- Secretaria da Receita Federal

Santarém
- Campo Experimental Belterra
- Centro de Tecnologia Madeireira (CTM)
- Comissão Pastoral dos Direitos Humanos (CPDH)
- Comissão Pastoral da Terra (CPT)
- Instituto Brasileiro de Desenvolvimento Florestal (IBDF)
- Grupo da Defesa da Amazônia (GDA)
- Sindicato dos Trabalhadores Rurais

Manáus
- Associação dos Exportadores da Zona Franca do Manáus
- Centro de Apoio á Pequena e Média Empresa - Amazonas (CEAG-AM)
- Comissão Pastoral da Terra (CPT)
- Conselho Indigenista Missionário (CIMI)
- Federação das Indústrias do Estado do Amazonas (FIEAM)
- Instituto Brasileiro de Desenvolvimento Florestal (IBDF)
- Instituto Nacional de Pesquisas Amazônicas
  . Departamento de Silvicultura Tropical
  . Departamento de Produtos Florestais
- Secretaria de Planejamento (SEPLAN) / Centro de Desenvolvimento da Amazônia (CODEAMA)
- Sindicato dos Madeireiros - Itacoatiara
- Sindicato das Serrarias
- Universidade do Amazonas

Porto Velho
- Centro de Apoio á Pequena e Média Empresa - Rondônia (CEAG-RO)
- Comissão Executivo dos Vales dos Rios Mamoré, Guaporé e Madeira (CEMAGUAM)
- Comissão Pastoral da Terra (CPT)
- Conselho Indigenista Missionário (CIMI)
- Departamento de Estatísticas e Informação - Coordenaria de Planejamento (COPLAN)
- Federação das Indústrias do Estado do Rondônia (FIERO)
- Instituto Brasileiro de Desenvolvimento Florestal (IBDF)
- Instituto Estadual de Florestas de Rondônia (IEF-RO)
- Secretaria de Planejamento (SEPLAN)
- Universidade Federal de Rondônia - Coordenação de Geografia

Rio Branco
- Centro de Apoio á Pequena e Média Empresa - Acre (CEAG-AC)
- Companhia de Desenvolvimento Industrial do Estado do Acre (CODISACRE)
- Conselho Indigenista Missionário (CIMI)
- Fundação de Tecnologia do Estado do Acre (FUNTAC)
- Instituto Brasileiro de Desenvolvimento Florestal (IBDF)

- Instituto do Meio Ambiente do Acre (IMAC)
- Secretaria de Indústria e Comércio (SIC)
- Secretaria de Planejamento (SEPLAN)
- Sindicato da Indústria de serrarias, carpinterias, tanoara, madeiras, compensados e laminados, aglomerados e chapas de madeiras do Estado do Acre

Appendix 2

Annual production of the surveyed sawmills according to location and output class (1988/89)

Location/ Output class	No. of sawmills Abs.	%	Average production (m^3)	Total production Abs. (m^3)	%
Belém	11	100.0	19,287	212,160	100.0
<500 m^3	-	-	-	-	-
500-2,499 m^3	-	-	-	-	-
2,500-4,999 m^3	3	27.3	3,070	9,210	4.3
≥5,000 m^3	8	72.7	25,368	202,950	95.7
Santarém	24	100.0	1,475	35,418	100.0
<500 m^3	14	58.3	176	2,466	7.0
500-2,499 m^3	6	25.0	1,217	7,302	20.5
2,500-4,999 m^3	3	12.5	3,950	11,850	33.5
≥5,000 m^3	1	4.2	13,800	13,800	39.0
Exit roads from Stm.	11	100.0	410	4,512	100.0
<500 m^3	8	72.7	212	1,692	37.5
500-2,499 m^3	3	27.3	940	2,820	62.5
2,500-4,999 m^3	-	-	-	-	-
≥5,000 m^3	-	-	-	-	-
Transamazônica	24	100.0	422	10,134	100.0
<500 m^3	19	79.1	202	3,834	37.8
500-2,499 m^3	4	16.7	855	3,420	33.8
2,500-4,999 m^3	1	4.2	2,880	2,880	28.4
≥5,000 m^3	-	-	-	-	-
Total	70	100.0	3,746	262,224	100.0
<500 m^3	41	58.6	195	7,992	3.1
500-2,499 m^3	13	18.5	1,042	13,542	5.1
2,500-4,999 m^3	7	10.0	3,420	23,940	9.1
≥5,000 m^3	9	12.9	24,083	216,750	82.7

Source: Author's fieldwork, 1989.

Appendix 3

Timber species used by surveyed sawmills

Common name[1]	Botanical name[2]	Number of sawmills: Santarém (n=60) Abs.	%	Belém (n=11) Abs.	%
Angelim		41	68.3	3	27.3
- Angelim (not spec.)		26	43.3	1	9.1
- Angelim pedra	*Hymenolobium petraeum* Ducke	13	21.7	2	18.2
- Angelim vermelho	*Dinizia excelsa* Ducke	8	13.3	2	18.2
Ipê (pau d'arco)	*Tabebuia* spp.	37	61.7	6	54.6
Jatobá	*Hymenaea courbaril* L.	35	58.3	6	54.6
Piquiá	*Caryocar villosum* (Aubl.) Pers.	32	53.3	-	-
Muiracatiara	*Astronium lecointei* Ducke	29	48.3	1	9.1
Maçaranduba	*Manilkara huberi* Ducke	25	41.7	3	27.3
Tatajuba	*Bagassa guianensis* Aubl.	23	38.3	3	27.3
Fava/Faveira/ Faveiro/Ataná	*Parkia multijuga* Benth./ *Parkia oppositifolia* Benth.	22	36.7	6	54.6
Cedrorana	*Cedrelinga catenaeformis* Ducke	22	36.7	-	-
Cedro (rosa)	*Cedrela odorata* L.	20	33.3	3	27.3
Quaruba	*Vochysia* spp.	18	30.0	1	9.1
Andiroba	*Carapa guianensis* Aubl.	11	18.3	1	9.1
Cumaru	*Dipteryx odorata* Willd.	11	18.3	2	18.2
Cupiuba	*Goupia glabra* Aubl.	10	16.7	-	-
Freijó	*Cordia goeldiana* Hub.	8	13.3	4	36.4
Sucupira	*Diplotropis* spp.	7	11.7	2	18.2
Gamela/Louro canela/ Louro vermelho	*Ocotea* spp. / *Nectandra* spp.	7	11.7	1	9.1
Jaraná	*Holopyxidium jarana* (Hub.) Ducke	7	11.7	-	-
Louro-faia	*Roupala* spp.	6	10.0	-	-
Mogno	*Swietenia macrophylla* King	5	8.3	3	27.3
Mandioqueira	*Qualea* spp.	3	5.0	1	9.1
Pau roxo/roxinho	*Peltogyne* spp.	3	5.0	-	-
Amapá	*Brosium* spp.	2	3.3	2	18.2
Itaúba	*Mezilaurus itauba* (Meissn.) Taub.	2	3.3	1	9.1
Virola	*Virola* spp.	1	3.3	5	45.5
Pau-amarelo	*Euxylophora paraensis* Hub.	1	1.7	2	18.2
Breu sucuruba	*Trattinickia burserifolia* Sw.	-	-	5	45.5
Sumauma	*Ceiba pentandra* (L.) Gaertn.	-	-	4	36.7
Others	(20 species)	9	15.0	6	54.6

1. Common names of wood species vary regionally.

2. Based on 'Nomenclatura comercial brasileira das madeiras tropicais amazônicas' compiled by IBDF, UFRRJ, IPT and INPA (IBDF, 1986). In case the of a common name covering different species, we compared this nomenclature with a list of species published by CTM, on the assumption that the latter indicates which species is most commonly found in our study area as it is based on the exploration of forests located in the environs of Santarém.

Appendix 4

Promising management systems for the sustainable production of timber in the Amazon

One of the management systems which is claimed to be ready for commercial use and applicable to most of the Amazonian rain forest (Hendrison, 1990) is the CELOS management system, developed in non-flooded tropical rain forest in Surinam.[1] This system is the result of more than 20 years of research and experiments involving various researchers of the Wageningen Agricultural University (de Graaf, 1982 and 1986; Jonkers & Schmidt, 1984; Boxman et al., 1985; Jonkers, 1987; de Graaf & Poels, 1990; Hendrison, 1990).

The CELOS management system which comprises of a harvesting system and a silvicultural system, was designed for mechanized selective logging operations in forests with sufficient potential for natural regeneration after logging. The harvesting system requires the careful planning of logging operations by the mapping of trees and terrain characteristics, roads and skid trails. Prior to felling, lianas and climbers are cut in order to reduce the damage to the remaining stand. To reduce skidder movement and the resulting soil compaction, the trees are felled in one single direction (directional felling) so that the hauling of logs is facilitated. Where possible, winches are used to extract the logs from the woods (Hendrison, 1990).

One or two years after the selective harvesting operation the silvicultural system is applied which was developed by de Graaf (1982 and 1986) and improved by Jonkers (1987).[2] It comprises various treatments, such as the elimination of undesired tree species through poison girdling and the cutting of lianas which are meant to give space to the trees of commercial value which regenerate or were left in the forest after logging. Eight to ten years after the first 'refinement', a second treatment of liberation thinning is applied.

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1. CELOS means the Centre for Agricultural Research in Suriname (Centrum voor Landbouwkundig Onderzoek in Suriname) which was a former institute of the Wageningen Agricultural University.
2. Jonkers' research focused on reducing the amount of arboricide to be used and on limiting poison girdling to the vegetation near to commercial trees.

A basic principle of the CELOS silvicultural system is that the vegetation killed off is left to decay in the forest in order to maintain a level of nutrients available to the remaining stand. This principle is based on the observation that rain forest vegetation absorbs nutrients from dead leaves, branches and trees rather than from the soil.

Regeneration is constantly monitored in order to plan future logging operations. With this system an annual diameter growth of 4 to 10 mm has been achieved (Boxman et al., 1985) corresponding with approximately 2 m^3 per hectare per year (de Graaf & Poels, 1990). This is four times as much as in selectively logged forests without silvicultural treatment. Expressed in the number of marketable trees, the net increase per hectare is approximately 13.5 trees in a cycle of 20 years, as compared with 2.7 trees with commercial value in untreated forests (Jonkers & Schmidt, 1984). On the basis of these results, the same forest tract can be logged again after 15 to 25 years with an expected harvest volume of 20-40 m^3 per hectare each cycle.

It is claimed that the CELOS management system results in a reduction of logging damage by as much as 40% at a felling intensity of 20 m^3 per hectare, whilst the harvesting costs per cubic metre are reduced as the increased productivity compensates for the additional costs of planning (Hendrison, 1990). The costs of silvicultural treatments are, however, an impediment to the application of the system on a commercial scale under current timber prices and concession systems (de Graaf, 1986).

The other natural forest management system which is regarded as being a promising initiative for the Amazon (Buschbacher, 1990) is the strip clear-cutting system which is being tested in the Palcazú valley in the Central Selva of Peru. It originated and is managed under quite different conditions from the CELOS management system described above. Whereas the CELOS management system was developed for highly mechanized operations and in conjunction with the timber industry, the strip clear-cutting system was initiated in the context of a rural development project.

The Central Selva Management project, supported by the United States Agency for International Development (USAID), aims at the sustained yield management of natural forests, while maintaining the cultural identity of the local indigenous people, the Amuesha (Yanesha) indians. A programme for mapping actual and potential land use in the lower valley, which was part of the project, indicated that about 44,000 ha of a total of approximately

100,000 ha were unsuitable for land uses other than sustained-yield forest management. From the economic point of view, the viability for sustainable forest management had increased as a result of the growing internal demand for timber products and the acceptance of an increased number of species (Hartshorn, 1989).

The strip clear-cutting system is based on silvicultural information about gap dynamics, i.e. the way that the forest regenerates in natural openings in the canopy. Starting from the principle that the surrounding intact forest provides seeds for regeneration, exploitation takes place in long narrow strips of 30-50 m width and 200-500 m in length. All the woody material in these strips is harvested. The smaller trees are harvested first to prevent their being injured when the larger trees are felled. Animal traction is used to extract the wood from the forest. Only small branches and leaves are left on the forest floor to provide nutrients for the new vegetation. New strips are opened at a minimum distance of 100 m from recently exploited strips, in order to maintain an adequate source of seeds. In strips that have been exploited so far, regeneration is abundant and rich in species. Various silvicultural treatments, such as climber cutting and liberation thinning are applied in order to favour desired species. It is expected that the same strip can be harvested again in cycles of 30-40 years. The undisturbed tracts of the forests allow for hunting and the exploitation of non-timber forest products (Hartshorn, 1989; Ocaña Vidal, 1992).

An interesting aspect of the Palcazú experiment is its socio-economic setting. The project is located in an area which was designated by the Peruvian government as a Yanesha Communal Reserve (Ocaña Vidal, 1992). Both forest exploitation and wood-processing is managed by the Yanesha Forest Co-operative and involves eight communities of Yanesha indians and 125 individuals (Hartshorn, 1990). All timber is processed locally. Logs with a diameter larger than 30 cm are used for sawnwood and the smaller ones receive a preservation treatment for use as telephone poles and construction posts. Other timber is used for the production of charcoal.

As the result of the property titles granted, wider land-use planning and forest management undertaken with the active involvement of the local population, the prospects for conservation and forest management have greatly improved while land conflicts as the result of invasion by colonists and loggers have decreased. Whether the project will be successful in the long-term depends on several factors such as the continuing land rights, the capacity of the co-operative to survive without outside financial support, its

determination to prevent the selling of logging rights to third parties or to increase harvesting beyond the level of sustainability and its management skills for coping with transport, maintenance and marketing problems (Hartshorn, 1989; Buschbacher, 1990; Ocaña Vidal, 1992). However, for the time being it is one of the very few experiences in forest management which can boast of the active participation of local people.

Appendix 5

The labour force in the timber industry: functions and general features

In addition to the workers in the forest whose work and division of labour were described in Chapter 4, the timber industry employs workers above all in the production phase. As not every sawmill employs its own logging team, most jobs are to be found in wood-processing. To operate a sawmill, at least one sawyer (*serrador*) and an assistant (*ajudante*) are needed. They put the log on a carriage with the help of a winch, set the desired gauge (*bitola*), and the log is driven along the saw. There may be various types of assistants at the band-saw: one for setting the dimensions (*bitoleiro*) and one who puts the logs on the saw and takes the planks away. The man who takes the planks off the saw is said to be at the 'mouth of the jaguar' (*boca da onça*), indicating that he runs the risk of having his fingers cut.

From the band-saw the rough planks go to the circular saw to be trimmed or edged. The workers engaged in these tasks are called *destopador* and *alinhador* or *canteador*, respectively. A central figure in the sawing operations is the grinder (*laminador*) who is responsible for the whetting of the saw-blades.

When processing is carried further, workers are needed for grading (*classificador*), planing (*plainador*), drying (*operador de secador*), packing (*empacotador*) and keeping the packing or shipping list (*romaneador*). As the number of employees increases there is also a need for one or more people who to divide and co-ordinate the work (*encarregado*). In addition, one or more people can be engaged in office tasks.

At the bottom of the hierarchy one can find the helpers (*servente* or *ajudante de serviços gerais*) who are principally engaged in tidying up and cleaning.

In 1989 we interviewed 60 workers in the timber industry of Santarém; 49 men and 11 women. Most of these workers were employed in the city but we also interviewed some forests workers employed by a company of Belém which operated in our study area. Some of their characteristics, such as their function, age, civil status, number of children, education and training are presented below.

As can be seen from table A5.1, the sample consists of a relatively high number of grinders and foremen. On average, sawmills in our study area employ only one grinder. Foremen are only to be found in larger sawmills. The fact that their share in the sample is relatively high is probably due to the method by which the respondents were recruited. When someone is asked to indicate a colleague for another interview he apparently tends to refer to someone belonging to the more stable section of the crew. This is not surprising in view of the high turnover of personnel in the lower echelons.

Table A5.1 Interviewed workers by category

Category	Number	%
Foreman	6	10%
Band sawyer	5	8%
Assistant	2	3%
Helper	13	22%
Grinder	8	13%
Circular sawyer	5	8%
Classifier	3	5%
Packer	3	5%
Office worker	1	2%
Truck driver	2	3%
Chain-saw operator	1	2%
Helper (forest)	3	5%
Operator of skidder or other machines used in the forest	3	5%
Other	5	8%
Total	60	100%

Source: Author's field research, 1989.

Table A5.2 shows that 86% of the workers interviewed were under 45 years. One third of the workers were single and two thirds were married. Eighty percent had to support one or more children (Table A5.3). More than half of the workers had no more than a few years schooling. Slightly more than one fifth had completed primary school and/or studied more than eight years (Table A5.4).

Table A5.2 Age of workers interviewed

Age	Number	%
Under 25	17	28%
25-34	17	28%
35-44	18	30%
45-54	7	12%
Over 54	1	2%
Total	60	100%

Source: Author's field research, 1989.

Table A5.3 Number of children supported by workers interviewed

Number of children	Number	%
None	13	22%
1-2	17	28%
3-4	17	28%
5-6	6	10%
More than 6	7	12%
Total	60	100%

Source: Author's field research, 1989.

Table A5.4 Schooling of workers interviewed

Number of years	Number	%
None	2	3%
1-4	33	55%
5-7	11	18%
Primary school completed	4	7%
High school (completed or not)	10	17%
Total	60	100%

Source: Author's field research, 1989.

Specific training courses for sawyers, grinders and classifiers, organized by the Technical Wood Centre of Santarém, had been attended by 12 people,

eight of whom had participated in the training course for sawyers and grinders, one participated in the training course for classifiers and three had participated in all of these courses. Two workers had participated in courses provided by the Industrial Training Service (SENAI) of the National Federation of Industries.

Appendix 6

Estimate of production costs and profit margin per output class

To estimate the average production costs and profit margins per output class we started out from and adapted the models which Uhl et al. used to this end in their studies of the timber industry in Tailândia and Paragominas (Uhl et al., 1991 and 1992; Veríssimo et al., forthcoming). The data on average production, prices of roundwood and products and salaries were obtained from our interviews with sawmill owners and managers and with workers in the timber industry. For the estimate of indirect labour costs, energy and maintenance costs and taxes, information has been used from the studies of Uhl et al.. On the basis of data from our survey, 1% has been added for administration and other costs. This has resulted in the following components in our estimates:

(a) Average production: information from Appendix 3.
(b) Average price: calculated on the basis of information provided by respondents on the minimum and maximum prices for their product.
(c) **Value of production**: a x b.
(d) Raw material: estimated on the basis of the average price per m^3 roundwood multiplied by twice the production (average roundwood utilization rate amounted to 50% for the sawmills in our survey). The average log price amounted to US$ 31 for small sawmills, US$ 31.27 for medium sawmills and US$ 48.75 for large and very large sawmills.[1]
(e) Salaries: average of the total sum per sawmill, calculated on the basis of its number of employees in the dry and rainy season and an average salary of US$ 128, taking into account the months that the sawmill stands idle during the rainy season.
(f) Indirect labour costs: 20% of the direct wage sum (Uhl et al., 1991).
(g) Energy: calculated on the basis of US$ 2.12/m^3 for sawmills located in Santarém and Belém, which run on electricity (price taken from Veríssimo et al., forthcoming) and US$ 3.44/m^3 for sawmills located

1. Average log price is higher for larger sawmills due to the species which are used. In calculating the average log price, the large and very large sawmills were taken together because of the small number of very large companies who provided data on this item.

in the colonization areas which run on diesel generators (based on Uhl et al., 1991).

(h) Taxes: 14.65% of the total value of production (Veríssimo et al., forthcoming).

(i) Maintenance: US$ 4.81/m^3 based on Uhl et al. (1991).[2]

(j) Other production costs: an additional 1% of the sum of aforementioned costs.

(k) Total production costs: the sum of d to j.

(l) Gross profit: c-k; depreciation and owner's salary not included.

(m) Profit margin: (l/c) x 100%.

Tables A6.1 to A6.4 show the results of these calculations for each output class.

Table A6.1 Estimate of production costs and profit margin for sawmills producing less than 500 m^3 per year

		Abs. (US$)	%
(a)	Average annual production	195 m^3	
(b)	Average price/m^3	129.85	
(c)	**Value of production**	**25,320.75**	
(d)	Raw material	12,090.00	56.6%
(e)	Salaries	6,278.24	29.4%
(f)	Indirect labour costs	1,255.65	5.9%
(g)	Energy	591.16	2.7%
(h)	Taxes		
(i)	Maintenance	937.95	4.4%
(j)	Other costs	211.53	1.0%
(k)	**Total production costs**	**21,364.53**	**100.0%**
(l)	**Gross profit**	**3,956.22**	
(m)	Profit margin		15.6%

Sources: Author's field research, 1989, after Uhl et al. (1991 and 1992).

2. Veríssimo et al. (forthcoming) estimate annual maintenance costs at for a typical sawmill in Paragominas which produces 4,300 m^3 per year US$ 13,020 (US$ 3.03/m^3). We prefer to use the estimate from the Tailândia study of Uhl et al. (1991) (US$ 1,540 per month for an average production of 320 m^3, corresponding to US$ 4.81/m^3) as the timber industry in Tailândia shows more similarity to the timber industry in our study area than the more diversified industry in Paragominas.

Table A6.2 Estimate of production costs and profit margin for sawmills producing between 500 and 2,499 m^3 per year

		Abs. (US$)	%
(a)	Average annual production	1,042 m^3	
(b)	Average price/m^3	188.83	
(c)	**Value of production**	**196,760.86**	
(d)	Raw material	65,166.68	47.3%
(e)	Salaries	28,888.62	20.9%
(f)	Indirect labour costs	5,777.72	4.2%
(g)	Energy	2,841.99	2.1%
(h)	Taxes	28,825.47	20.9%
(i)	Maintenance	5,012.02	3.6%
(j)	Other costs	1,365.12	1.0%
(k)	**Total production costs**	**137,877.62**	**100.0%**
(l)	**Gross profit**	**58,983.24**	
(m)	Profit margin		29.9%

Sources: Author's field research, 1989, after Uhl et al. (1991 and 1992).

Table A6.3 Estimate of production costs and profit margin for sawmills producing between 2,500 and 4,999 m^3 per year

		Abs. (US$)	%
(a)	Average annual production	3,420 m^3	
(b)	Average price/m^3	273.33	
(c)	**Value of production**	**934,788.60**	
(d)	Raw material	333,450.00	49.7%
(e)	Salaries	140,982.86	21.0%
(f)	Indirect labour costs	28,196.57	4.2%
(g)	Energy	7,793.49	1.2%
(h)	Taxes	136,946.52	20.4%
(i)	Maintenance	16,450.02	2.5%
(j)	Other costs	6,638.19	1.0%
(k)	**Total production costs**	**670,457.65**	**100.0%**
(l)	**Gross profit**	**264,330.95**	
(m)	Profit margin		28.3%

Sources: Author's field research, 1989, after Uhl et al. (1991 and 1992).

Table A6.4 Estimate of production costs and profit margin for sawmills producing more than 5,000 m^3 per year

		Abs. (US$)	%
(a)	Average annual production	24,083 m^3	
(b)	Average price/m^3	273.33	
(c)	**Value of production**	**6,582,606.30**	
(d)	Raw material	2,348,092.50	55.0%
(e)	Salaries	623,274.67	14.6%
(f)	Indirect labour costs	124,654.93	2.9%
(g)	Energy	51,056.67	1.2%
(h)	Taxes	964,351.82	22.6%
(i)	Maintenance	115,839.23	2.7%
(j)	Other costs	42,272.70	1.0%
(k)	**Total production costs**	**4,269,542.52**	**100.0%**
(l)	**Gross profit**	**2,313,063.78**	
(m)	Profit margin		35.1%

Sources: Author's field research, 1989, after Uhl et al. (1991 and 1992).

Acronyms

ABPM	Associação Brasileira de Produtores de Madeiras: Brazilian Association of Timber Producers.
AIMEX	Associação das Indústrias Madeireiras Exportadoras dos Estados do Pará e Amapá: Association of Exporting Timber Industries of the States of Pará and Amapá.
AC	Acre (federal state).
AM	Amazonas (federal state).
AMATA	Associação dos Madeireiros de Tailândia: Association of Timber Producers of Tailândia.
AP	Amapá (federal state).
ASEAN	Association of South East Asiatic Nations.
BASA	Banco da Amazônia Sociedade Anónima: Bank for the Amazon Ltd.
CACEX	Carteira do Comércio Exterior: Brazilian foreign trade regulatory agency.
CEAG	Centro de Apoio à Pequena e Média Empresa: Centre for Support of the Small and Medium Enterprise (established in all state capitals).
CEBRAP	Centro Brasileiro de Pesquisas Econômicas: Brazilian Centre for Economical Research (São Paulo).
CEDEPLAR	Centro de Desenvolvimento e Planejamento Regional: Centre for Regional Development and Planning (Federal University of Minas Gerais).
CEMAGUAM	Comissão Executivo dos Vales dos Rios Mamoré, Guaporé e Madeira: Executive Committee of the Basins of the Rivers Mamoré, Guaporé and Madeira (Porto Velho).
CIMI	Conselho Indigenista Missionário: Missionairy Council for the Indigenous People (Brasília).
CNBB	Conselho Nacional dos Bispos do Brasil: National Synod of Brazilian Bishops (Brasília).
CNDDA	Campanha Nacional de Defesa e pelo Desenvolvimento da Amazônia: National Campaign for the Defence and Development of the Amazon (Rio de Janeiro).
COBEC	Companhia Brasileira de Exportação e Comércio: Brazilian State Company for Export and Trade in PROMAEX.
CODISACRE	Companhia de Desenvolvimento Industrial do Estado do Acre: Company for the Industrial Development of the State of Acre.
CONAMA	Conselho Nacional do Meio Ambiente: National Council for the Environment.
CPATU	Centro de Pesquisa Agropecuária do Trópico Úmido: Centre for Agronomic Research of the Humid Tropics (EMBRAPA, Belém).
CPDH	Comissão Pastoral dos Direitos Humanos: Pastoral Committee for the Human Rights.
CPT	Comissão Pastoral da Terra: Pastoral Land Committee.

CSMA	Conselho Superior do Meio Ambiente: Superior Council for the Environment.
CTM	Centro de Tecnologia Madeireira: Centre for Wood Technology (Santarém).
EC	European Community.
EIA	Estudo de Impacto Ambiental: Environmental Impact Study.
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária: Brazilian State Company for Agricultural Research (also involved in forestry).
EMBRATER	Empresa Brasileira de Assistência Técnica e Extensão Rural: Brazilian State Company for Technical Assistence and Rural Extension.
FAO	Food and Agricultural Organisation of the United Nations.
FASE	Federação dos Orgãos para a Assistência Social: Federation of Organs for Social Assistence.
FBCN	Fundação Brasileira para a Conservação da Natureza: Brazilian Foundation for the Conservation of Nature.
FCAP	Faculdade de Ciências Agrárias: Faculty of Agricultural Sciences (Belém).
FIDAM	Fundo de Investimentos no Desenvolvimento da Amazônia: Investment Fund for the Development of the Amazon (predecessor of FINAM).
FIEAM	Federação das Indústrias do Estado do Amazonas: Federation of Industries of the State of Amazonas.
FIEPA	Federação das Indústrias do Estado do Pará: Federation of Industries of the State of Pará.
FIERO	Federação das Indústrias do Estado do Rondônia: Federation of Industries of the State of Rondônia.
FINAM	Fundo de Investimentos da Amazônia: Investment Fund for the Amazon.
FUNAI	Fundação Nacional do Índio: National Foundation of the Indians.
FUNTAC	Fundação de Tecnologia do Estado do Acre: Foundation of Technology of the State of Acre.
GDA	Grupo da Defesa da Amazônia: Group for the Defence of the Amazon (Santarém).
IBAMA	Instituto Brasileiro do Meio Ambiente e Recursos Naturais Renováveis: Brazilian Institute for the Environment and Renewable Resources.
IBASE	Instituto Brasileiro de Análise Social e Econômico: Brazilian Institute for Social and Economic Analysis (Rio de Janeiro).
IBDF	Instituto Brasileiro de Desenvolvimento Florestal: Brazilian Institute for Forest Development (predecessor of IBAMA).
IBGE	Instituto Brasileiro de Geografia e Estatística: Brazilian Institute for Geography and Statistics.
IDESP	Instituto do Desenvolvimento Econômico do Estado do Pará: Institute for the Economic Development of the State of Pará (Belém).
IEF-RO	Instituto Estadual de Florestas de Rondônia: State Institute of the Forests of Rondônia.

IMAC	Instituto do Meio Ambiente do Acre: Institute for the Environment of the State of Acre.
IMAZON	Instituto do Homem e o Meio Ambiente da Amazônia: Institute for Man and the Environment of the Amazon (Belém).
INCRA	Instituto Nacional de Colonização e Reforma Agraria: National Institute for Colonization and Land Reform (predecessor of MIRAD).
INESC	Instituto Nacional de Estudos Económicos: National Institute for Economic Studies (Brasília).
INPA	Instituto Nacional de Pesquisas Amazônicas: National Institute for Amazon Research (Manáus).
INPE	Instituto de Pesquisas Espaçiais: Institute for Spatial Research (São José dos Campos, São Paulo).
INPS	Instituto Nacional de Previdência Social: National Institute for Social Welfare.
IPEA	Instituto Brasileiro de Planejamento Econômico e Social: Brazilian Institute of Socio-economic Planning (Brasília).
IPT	Instituto de Pesquisas Tecnológicas - Divisão de Madeiras: Institute of Technological Research - Wood Division (University of São Paulo).
ITTA	International Tropical Timber Agreement.
ITTC	International Tropical Timber Council.
ITTO	International Tropical Timber Organization.
LANDSAT	Satellite which makes spectrum photographs of the earth's surface.
MA	Maranhão (federal state).
MIRAD	Ministério de Reforma Agrária e Desenvolvimento Rural: Ministery of Land Reform and Rural Development.
MUS	Malaysian Uniform System.
NAEA	Núcleo dos Altos Estudos Amazônicos: Nucleus for Superior Amazonian Studies (Federal University of Pará, Belém).
PA	Pará (federal state).
PDA	Plano de Desenvolvimento da Amazônia: Development Plan for the Amazon region.
PIFI	Plano Integrado Floresta-Indústria: Integrated Forest-Industry Plan.
PIN	Programa de Integração Nacional: Programme for National Integration.
PND	Programa Nacional de Desenvolvimento: National Development Plan.
POLAMAZÔNIA	Programa dos Polos Agropecuários e Agrominerais da Amazônia: Programme for Agricultural and Mining Poles in the Amazon.
PROMAEX	Programa de Entrepostos Madeireiros para Exportação: Programme for Entrepôts for Exportation Timber.
PROTERRA	Programa de Redistribuição de Terras e de Estímulo à Agroindústria do Norte e Nordeste: Programme for Land Redistribution and Incentivation of the Agro-industry of the North and Northeast.
PT	Partido dos Trabalhadores: Workers' Party.
RADAMBRASIL	Radar da Amazônia-Brasil: inventory of natural resources of the Amazon through aerial photographs.

RIMA	Relatório de Impacto Ambiental: Report on the Environmental Impact Study.
RO	Rondônia (federal state).
RR	Roraima (federal state).
SDB	Superintendência da Defesa da Borracha: Superintendency for the Defence of Rubber (predecessor of SUDHEVEA).
SEMA	Secretaria do Meio Ambiente: Secretariat for the Environment.
SENAI	Serviço Nacional de Aprendizagem Industrial: National Industrial Training Service.
SEPLAN	Secretaria de Planejamento: Secretary of Planning.
SIC	Secretaria de Indústria e Comércio: Secretary for Industry and Trade.
SINE	Serviço Industrial Nacional de Emprego: National Industrial Employment Service (governmental employment office).
SPVEA	Superintendência da Valorização Econômica da Amazônia: Superintendency for the Economical Valorization of the Amazon region (predecessor of SUDAM).
STR	Sindicato de Trabalhadores Rurais: Trade Union of Rural Workers.
SUDAM	Superintendência do Desenvolvimento da Amazônia: Superintendency for the Development of the Amazon.
SUDEPE	Superintendência da Pesca: Superintendency for the Fishery.
SUDHEVEA	Superintendência da Borracha: Superintendency for Rubber.
SUFRAMA	Superintendência da Zona Franca do Manáus: Superintendency for the Manáus Free Trade Zone.
TSS	Tropical Shelterwood System.
UFRRJ	Universidade Federal Rural do Rio de Janeiro: The Federal Rural University of Rio de Janeiro.
UNCTAD	United Nations Conference on Trade and Development.
UNDP	United Nation Development Plan.
UNESCO	United Nations Educational, Scientific and Cultural Organization.

Glossary

Terms in English

hardwood	Wood from broadleaved or non-coniferous trees.
log	Lenghth of tree-trunk of several metres, used as raw material for sawmills or other wood-processing industries.
plywood	Boards made by gluing thin layers of wood on top of each other.
roundwood	Unprocessed logs.
sawnwood	The product of basic wood-processing whereby logs are sawn lengthwise.
skidder	Machine used to drag cut boles out of the forest.
softwood	Wood from coniferous trees.
veneer	Sheets produced by peeling or slicing logs and which is used for the production of plywood or as a thin decorative layer in furniture making.

Terms in Portuguese

ajudante	Helper, assistant.
aprontar madeira	To saw the trunk of a felled tree into logs in order to transport it out of the forest.
aviador	Intermediary supplying merchandise to the extractors of forest products in exchange for the products collected.
aviamento	Traditional relationship between the extractors and the merchants of forest products characterized by advancing food and material to the extractors in exchange for the physical product of the extractive activity and generally resulting in a permanent debt to the *aviador*.
balsa	Barge.
bitola	The gauge of a board or plank.
boca da onça	Literally: mouth of the jaguar. In a sawmill the position from where the sawnwood must be removed from the sawing-machine.
braçal	Unskilled worker.

caboclo	Portuguese speaking descendants of white and indigenous people living in the inland communities in the Amazon. They generally live by subsistence farming, hunting, fishing and the extraction of forest products.
cacique	Indian tribal chief.
capataz	Foreman.
capoeira	Secondary vegetation on cleared land.
carregadeira	Front-end loader.
chefe da turma	Chief logger (used in case of autonomously working lumbermen).
Código Florestal	Brazilian Forest Code.
colocação	Transportation of logs by hand over poles from the felling site to the nearest watercourse (in *várzea* forests).
compadre	Godfather or companion.
comprar por árvore	To buy trees for timber and pay for them per felled tree.
convidado	Lumberman invited by a relative or neighbour to go out logging in exchange for a share in the profits.
cota florestal	Forest share which wood-processing industries have to pay to the Forestry Service for reforestation.
delegacia	Regional office of federal agencies such as the IBAMA.
derrubada	Felling of trees.
derrubada por empreitada	Contract logging.
direito de posse	Right to land ownership obtained by its occupation and appropriation.
deixar em pico	Tree marking.
deixar na beira da estrada	To deliver logs to a landing along the road.
deixar na beira do rio	To deliver logs to a landing along the river-side
derrubar madeira	Tree felling.
diarista	Lumberman paid a daily wage.
embarcar na catraca	Loading a logging truck by winch.
empilhadeira	Front-end loader (cf. carregadeira).
empreiteiro	Subcontractor employed temporarily in clearing or agriculture.
explorar	To look for and identify desired tree species.
farinha	Cassava.
fazenda	Large estate.

fazendeiro	Large landholder.
fazer ramal	Clearing of small logging roads.
fazer o rego	Cleaning of a watercourse for the transportation of logs out of the woods (in *várzea* forests).
florestas de rendimento	Production forests to be demarcated for large-scale integrated wood-processing industries which manage these forests on a sustainable basis (see Chapter 2, Pandolfo's proposal).
igarapé	Small inland watercourse.
Induspa	Transportable sawmill which saws logs simultaneously crosswise and lenghthwise.
garimpo	Gold or diamond mine.
girico	Tractor with wheels.
grilagem	Land-grabbing by false documents or fraud with titles.
guía florestal	Way-bill for the transport of logs or timber products.
jangada	Raft.
laminador	Grinder.
levas	Supporting poles used for loading a logging truck.
limpar o virador	To clear a small loading area in the forest which is large enough for a logging truck to turn.
machado	Axe.
madeireiro	Lumberman living from the extraction and transportation of logs to timber merchants or sawmills.
mateiro	Explorer who identifies desired tree species.
motorista	Truck driver.
motoserrista	Chain-saw operator.
niveladora	Equalizer.
pátio	In the forest: loading yard. At the sawmill: yard where the logs are stored.
patrão	Literally: boss; in the extractive economy the buyer of forest products.
pica pau	Literally: wood-pecker; small rudimentary sawmill with one horizontal blade.
pistoleiro	Gunman.
portaria	Governmental regulation.
posseiro	Land occupier who claims that land.
Previdência Social	Social Welfare.
proprietário	Landholder with a legal title to the land.
puxar a carrada	To load a logging truck by winch (cf. *embarcar na catraca*).
rebocador	Towboat.

roladeira	Two-handled cross-cut saw.
safra	Literally: harvest; in this study the season of log supplies (generally used for roundwood supplies from *várzea* forests).
seringalista	Owner of rubber trees.
seringueiro	Rubber tapper.
serrador	Sawyer.
serrotão	See *roladeira.*
Sociedade Anónima	Limited liability company.
terçado	Machete.
terceiro	Intermediary.
terra devoluta	Unclaimed public land.
terra firme	Non flooded upland forests.
torar	To saw a trunk into logs.
(trator de) esteira	Bulldozer.
trazer a madeira	Transport the logs from the forest to the sawmill.
toreiro	See *madeireiro.*
várzea	Seasonally inundated lowland forest along the watercourses.
xeque-xeque	See *pica pau.*
zoneamento econômico ecológico	Agro-ecological zoning or land-use planning.

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Samenvatting en conclusies

Deze studie had tot doel de ruimtelijke en sociaal-economische kenmerken van de houtsector in het Braziliaanse Amazonegebied te beschrijven en te analyseren wat de sociale, economische en ecologische gevolgen zijn van de houtexploitatie. We wilden daarbij een antwoord vinden op de vraag welke bijdrage de winning en verwerking van hardhout levert aan de duurzame ontwikkeling van het Amazonegebied.
Deze centrale vraag hebben we gesplitst in vier onderzoeksvragen:

1. Welke vormen van houtwinning zijn in het Braziliaanse Amazonegebied te onderscheiden, wat zijn hun ruimtelijke en sociaal-economische kenmerken en hoe zijn de verschillende vormen beïnvloed door geleide en spontane ontwikkelingen?
2. Welke vormen van rondhoutvoorziening zijn te onderscheiden in het Amazonegebied, wat zijn de ecologische gevolgen van de houtwinning en wat zijn de vooruitzichten voor duurzame houtkapmethoden?
3. Welke rol speelt de houtsector in de sociaal-economische ontwikkeling van het Amazonegebied en de incorporatie van de regio in de nationale en internationale economie?
4. Welke rol speelt de houtsector in het Braziliaanse Amazonegebied op de nationale en internationale markt voor tropisch hardhout en welke invloed kunnen handelsmaatregelen uitoefenen op de duurzaamheid van de houtkap?

Na een korte weergave van de wijze waarop het onderzoek is uitgevoerd, zullen we hierna de belangrijkste bevindingen uit het onderzoek samenvatten en bespreken.

Opzet en uitvoering van het onderzoek

Het onderzoek is uitgevoerd in een gebied tussen de Amazonerivier en de Transamazone-weg, in de omgeving van de stad Santarém in het westelijk deel van de deelstaat Pará. Het onderzoeksgebied beslaat een oppervlakte van circa 30.000 km^2, verdeeld over drie gemeenten (Santarém, Rurópolis en Uruará). De belangrijkste reden om deze streek te kiezen was dat Santarém één van de oudere houtverwerkende centra is van het Amazonegebied, terwijl in de omgeving van de stad veel nieuwe houtzagerijen zijn gevestigd door de openlegging van het gebied. Dat bood de mogelijkheid

om zowel de traditionele vormen van houtwinning te bestuderen als die welke het gevolg zijn van recente ontginningen.

In 1989 telde dit gebied 60 houtzagerijen, die behalve in de stad Santarém allemaal gevestigd waren langs de drie wegen die het gebied doorkruisen (de Transamazone-weg, de weg van Santarém naar Cuiabá en die van Santarém naar Curua Una). Al deze bedrijven zijn bezocht voor een interview, dat gegevens opleverde over de vestigingsfactoren, de grondstofvoorziening, de gecreëerde werkgelegenheid, de werving van de arbeiders, de produktie, de gebruikte machines, de bestemming van de produktie, de relatie met overheidsinstanties en de economische aspecten van de houtverwerking. Omdat het onderzoeksgebied weinig heel grote ondernemingen telde, zijn deze interviews ook afgenomen bij elf grote ondernemingen in de stad Belém.

Om meer informatie te krijgen over de arbeidsomstandigheden en de kenmerken van werknemers in de houtsector zijn ook 60 arbeiders geënquêteerd. Daarnaast zijn open vraaggesprekken gehouden met negen zelfstandig werkende houtkappers, die rondhout (moten stam) verkopen aan de houtzagerijen. Vertegenwoordigers van sociale organisaties als vakbonden, milieugroepen en basisgemeenschappen binnen de katholieke kerk zijn geïnterviewd om meer informatie te krijgen over de sociale gevolgen van de houtwinning.

Een laatste onderdeel van het veldwerk bestond uit het observeren van verschillende vormen van houtkap, variërend in schaal en technologisch niveau. We hebben daarbij gelet op de organisatie van het werk, de arbeidsverdeling, de produktiviteit, de schade aan de begroeiing, de arbeidsvoorzieningen en het risico van arbeidsongevallen.

Bij de uitwerking van de gegevens hebben we ook gebruik gemaakt van studies uit andere delen van het Amazonegebied, om na te gaan hoe onze bevindingen zich verhouden tot resultaten van onderzoek in andere gebieden. Aanvullende informatie en achtergrondmateriaal is tevens gezocht in overheidsrapporten, niet gepubliceerde onderzoeksverslagen en scripties uit Brazilië, statistische publikaties, documenten van niet-gouvernementele organisaties en kranteartikelen.

Achtergrond en kenmerken van de houtexploitatie

De eerste onderzoeksvraag betreffende de verschillende vormen en kenmerken van houtwinning en de spontane en geleide ontwikkelingen die

de groei van de houtsector hebben beïnvloed, hebben we uitgewerkt in de hoofdstukken 2, 3 en 4.

In hoofdstuk 2 plaatsten we de groei van de houtsector in het Amazonegebied tegen de achtergrond van spontane en geleide ontwikkelingen op nationaal niveau. We zagen dat de houtverwerkende industrie van oudsher in andere delen van Brazilië was gevestigd, met name in de buurt van de naaldbossen met hoogwaardig Parana pine (*Araucaria angustifolia*) in het meer ontwikkelde zuiden van het land. Door uitputting van deze bossen werden de grondstoffen steeds schaarser en moest worden gezocht naar alternatieve bronnen.

Het Amazonegebied werd een steeds aantrekkelijker alternatief voor de houtindustrie door het actieve beleid van de Braziliaanse overheid in de jaren '60 en '70 om deze regio open te leggen en tot ontwikkeling te brengen. Er werden enkele grote wegen aangelegd, die voorheen ontoegankelijke houtvoorraden bereikbaar maakten en zorgden voor een verbinding tussen de grondstofbronnen en de afnemers van hardhout. De migratie naar het Amazonegebied werd aangemoedigd en kwam ook spontaan op gang, zodat het traditionele gebrek aan arbeidskrachten werd ondervangen. Grond was goedkoop en grote ondernemingen konden profiteren van belastingvoordelen als ze investeerden in het Amazonegebied. Door de sterke groei van ontginningen voor akkerbouw en veeteelt groeide in de kolonisatiegebieden het aanbod van goedkope grondstoffen. Specifieke maatregelen om de bosbouw te stimuleren sorteerden weinig effect. Door meer aandacht voor onderzoek naar hout in het Amazonegebied werd wel steeds meer bekend over de houtopstand en de eigenschappen en de bruikbaarheid van houtsoorten die voorheen onbekend waren.

In hoofdstuk 3 beschreven we de kenmerken van de houtsector in het Amazonegebied. Daarin kwam de hierboven geschetste achtergrond van openlegging en kolonisatie sterk tot uitdrukking. Van oudsher vond de houtwinning plaats in gebieden die toegankelijk waren via de rivieren en concentreerde de verwerking zich in de steden Belém, Manáus en, in mindere mate, Santarém. Met de aanleg van grote wegen en de ontginning van grote stukken bos, heeft de exploitatie zich verplaatst naar de kolonisatiegebieden. De belangrijkste centra van houtwinning en -verwerking zijn nu te vinden langs de wegen in recent opengelegde gebieden, zoals het oosten en zuiden van de deelstaat Pará, het noorden van Mato Grosso en de deelstaat Rondônia. De meeste eigenaren van de bedrijven komen uit

andere delen van Brazilië: voornamelijk uit het zuiden en in mindere mate uit het noordoosten.

De houtsector in het Amazonegebied omvat duizenden kleine zagerijen die over de hele regio verspreid op het platteland zijn te vinden. Het zijn deze bedrijfjes die nauw zijn verbonden met het kolonisatieproces. Vaak zijn ze niet meer dan enkele jaren oud en worden ze na enkele jaren weer beëindigd. Ze functioneren in de meeste gevallen als nevenbedrijf naast de landbouw, waarbij gebruik wordt gemaakt van het aanbod van bomen, die worden geveld bij ontginningen op het eigen land of van boeren in de omgeving. De bewerking gaat meestal niet verder dan ruw gezaagde planken. De uitrusting is eenvoudig en meestal verouderd. In de regentijd wordt de produktie stilgelegd omdat de wegen dan onbegaanbaar worden en er geen geld is om voorraden aan te leggen. De omvang van de produktie overstijgt zelden de 500 m^3 per jaar.

Ook de kleine zagerijen in de stad Santarém verwerken hout afkomstig van land bestemd voor ontginningen. In deze gevallen worden de grondstoffen geleverd door tussenpersonen: zelfstandige houtkappers die in Brazilië *madeireiros* of *toreiros* worden genoemd. In totaal behoorde ruim tweederde van de bedrijven in ons onderzoeksgebied tot de categorie van kleine houtzagerijen. Hun gezamenlijke produktie bedroeg echter niet meer dan 16% van de totale houtproduktie in de regio Santarém.

Naast enkele middelgrote houtzagerijen in rurale gebieden, zijn de grote houtzagerijen, die primair zijn opgezet als houtbedrijf, vooral te vinden in de steden. De produkten van deze bedrijven ondergaan een verdere bewerking en worden beter afgewerkt. Hoewel hun produktie in het algemeen als laag wordt beschouwd, ligt deze beduidend hoger dan bij de kleine zagerijen. De middelgrote zagerijen produceren gemiddeld ruim 1.000 m^3 per jaar, terwijl de gemiddelde jaarproduktie voor de grote houtzagerijen ruim 3.400 m^3 bedraagt. In het onderzoeksgebied behoorde 22% van de bedrijven tot de middelgrote zagerijen met een produktie tussen de 500 en 2.500 m^3 per jaar. Slechts 7% hoorde tot de grote zagerijen met een jaarlijkse produktie tussen de 2.500 en 5.000 m^3. Hun aandeel aan de totale produktie in het gebied bedroeg respectievelijk 27% en 29%.

Een vierde categorie van bedrijven wordt gevormd door de grote houtverwerkende industrieën. Zowel qua soort produkten (parket, fineer, multiplex) als produktie-omvang (meer dan 5.000 m^3 per jaar) lijken deze ondernemingen weinig op de kleinere bedrijven. Hoewel deze ondernemingen in aantal een minderheid vormen, reikt hun invloed door de grotere

schaal waarop ze opereren aanzienlijk verder dan die van de andere bedrijven. Een deel van de produktie van kleine houtzagerijen komt bij de grote bedrijven terecht, om zo een weg te vinden naar de exportmarkt. Hoewel in ons onderzoeksgebied slechts één bedrijf tot de categorie van zeer grote bedrijven kon worden gerekend, zorgde het wel voor ruim een kwart van de produktie.

In hoofdstuk 4 hebben we onderzocht hoe de bedrijven aan hun grondstoffen komen. We concludeerden dat slechts een beperkt aantal boomsoorten wordt gebruikt, waarbij voor het Amazonegebied als geheel mahonie (*Swietenia macrophylla*) en baboen (*Virola* spp.) de belangrijkste zijn. We beschreven verschillende vormen van houtkap, variërend in schaal en technologisch niveau. Een bepalend onderscheid bleek dat tussen *várzea* bossen, die in de regentijd onder water staan, en de hoger gelegen *terra firme* bossen. Zowel de organisatie van de houtkap, de gebruikte arbeidsmiddelen en het transport van de stammen tonen belangrijke verschillen in beide situaties.

De *várzea* bossen zijn in het algemeen publiek domein. Ze zijn alleen over het water (en daarmee moeilijker) te bereiken. Traditionele houtkapmethoden overheersen. Veel werk wordt met de hand gedaan en de stammen worden aaneengeschakeld of in duwbakken over het water vervoerd. De houtkappers werken zelfstandig, maar krijgen wel een voorschot in de vorm van voedsel en materiaal van degene die het hout van hen opkoopt. De arbeidsrelatie met de opkoper - een tussenhandelaar of de zagerij - vertoont daarmee grote overeenkomst met de schuldrelatie die rubbertappers van oudsher hebben met de handelaren, en die wordt aangeduid met het *aviamento* systeem. De onderzochte grote bedrijven in Belém betrokken 48% van hun grondstoffen direct of via een tussenhandelaar van houtkappers die in *várzea* bossen werken.

In de *terra firme* bossen wordt gekapt in de delen die bereikbaar zijn via de weg. Dat zijn over het algemeen de stukken bos die in het bezit zijn van de kolonisten, hoewel in mindere mate ook verder weg gelegen publiek domein wordt geëxploiteerd. In de *terra firme* bossen is in principe de inzet van zware machines mogelijk. Of deze ook worden gebruikt is afhankelijk van degene die de houtkap uitvoert. We zagen dat veel bedrijven niet zelf kappen, maar de grondstoffen afnemen van zelfstandig werkende houtkappers. Deze werken op kleine schaal, met een kettingzaag, een kapmes en een vrachtwagen die is uitgerust met een lier voor het laden van de stammen. Deze wijze van werken wordt ook gehanteerd door de kleine

zagerijen in de kolonisatiegebieden. De bomen worden gekapt in stukken bos waar kleine boeren (vaak de houtkapper of de eigenaar van de zagerij zelf) van plan zijn landbouwgrond aan te leggen. Op deze wijze werd door 23% van de onderzochte bedrijven gewerkt.

De middelgrote zagerijen die de houtkap zelf ter hand nemen, werken op iets grotere schaal, omdat ze naast de kettingzaag en de vrachtwagen de beschikking hebben over een extra machine. In de kolonisatiegebieden, waar houtwinning en landbouw hand in hand gaan, wordt in deze gevallen vaak een landbouwtrekker gebruikt om de stammen uit het bos te slepen. De zagerijen uit de stad die op dit tussenniveau werken, gebruiken eerder een bulldozer of een voorlader. Van de onderzochte bedrijven werkten 21% op dit niveau.

Bij grootschalige gemechaniseerde houtkap wordt gebruik gemaakt van bulldozers, voorladers en speciale bostrekkers (*skidders*). Daarbij is sprake van een vergaande arbeidsdeling tussen de arbeiders. Slechts enkele grote bedrijven (14% van het totale aantal dat werd onderzocht) werken op deze schaal. Voor een deel wordt daarbij in maagdelijk bos gekapt. Maar ook de grootschalige exploitatie is nog in sterke mate verbonden met ontginningen, door middel van kapovereenkomsten met grootgrondbezitters die bos willen omzetten in weidegrond.

Ruim twee vijfde (42%) van de onderzochte bedrijven waren voor de grondstofvoorziening volledig afhankelijk van derden. Maar ook bedrijven die zelf hout kappen, betrekken een deel van hun grondstoffen van tussenpersonen. In totaal was 80% van de verbruikte grondstoffen afkomstig van houtkappers die niet rechtstreeks in dienst waren van de houtzagerijen.

Onze conclusies met betrekking tot de eerste onderzoeksvraag kunnen als volgt worden samengevat:

- De laatste 30 jaar is in het Braziliaanse Amazonegebied een nieuwe vorm van houtexploitatie ontstaan, die nauw samenhangt met de kolonisatie van het gebied en de ontginningen voor akkerbouw en veeteelt. Dat heeft geresulteerd in een sterke toename van met name kleine houtzagerijen in recent opengelegde en in cultuur gebrachte gebieden.
- Daarnaast heeft de openlegging van nieuwe houtvoorraden grote industriële ondernemingen aangetrokken uit Zuid-Brazilië, waar de grondstoffen steeds schaarser werden. In beperkte mate is de verplaatsing van deze bedrijven ook beïnvloed door de belastingvoordelen die grote

bedrijven kunnen krijgen als ze investeren in het Amazonegebied. Deze grote bedrijven zijn voornamelijk gevestigd in de steden.
- In de houtwinning overheerst kleinschalige houtkap, waarbij zelfstandige houtkappers een centrale rol spelen. Daarin blijft plaats voor traditionele vormen van houtwinning en de daarbij behorende arbeidsrelaties.
- De relatie van de houtzagerijen tot de grondstofbron is veelal indirect van aard: òf de bedrijven kappen niet zelf, òf ze doen dat in veel gevallen op grond van anderen. Deze indirecte relatie is weinig bevorderlijk voor het toepassen van duurzame houtkapmethoden.

Ecologische gevolgen en mogelijkheden voor duurzaam bosbeheer

De onderzoeksvraag betreffende de ecologische gevolgen van de houtkap en de vooruitzichten voor duurzame houtwinning hebben we uitgewerkt in hoofdstuk 5. Uit de literatuur komt naar voren dat gemechaniseerde houtkap bij de huidige praktijken slechts een paar procent van de bomen op een hectare worden geoogst, maar dat daarvoor een kwart tot de helft van het geëxploiteerde bos wordt vernietigd of onherstelbare schade ondervindt. Daarnaast leidt de gemechaniseerde houtkap tot vermindering van het aantal boom- en diersoorten, bodemerosie en -verdichting, genetische verarming en verhoogde gevoeligheid voor bosbranden.

Selectieve houtkap zonder gebruik van zware machines leidt tot aanzienlijk minder schade. Weliswaar dreigt ook in dat geval het gevaar van het schaarser worden van de meest waardevolle soorten, maar de schade aan de niet gekapte bomen is veel minder (circa 10%), terwijl geen invloed is waar te nemen op de wildstand.

Jaarlijks wordt in het Braziliaanse Amazonegebied naar schatting 10.000 km^2 bos geëxploiteerd voor de houtwinning. Door het overheersen van kleinschalige houtkap en de nauwe samenhang met ontginningen voor landbouw en veeteelt, kan de houtwinning echter niet tot de belangrijke oorzaken van de ontbossing in het gebied worden gerekend. Deze oorzaken moeten primair worden gezocht in de vestiging van uitgestrekte veeteeltbedrijven, ontginningen ten behoeve van kleine landbouwbedrijven, de aanleg van wegen en stuwdammen en grootschalige mijnbouwprojecten.

Daar wordt verwacht dat de grootschalige houtkap in de komende jaren in betekenis zal toenemen, is de ontwikkeling van duurzame houtkapmethoden van groot belang. Op basis van de literatuur kon worden vastgesteld dat de technische mogelijkheden daarvoor momenteel aanwezig zijn, al laten

proefprojecten zien dat nader onderzoek nodig is om deze methoden aan te passen aan de omstandigheden in het Amazonegebied.

Belangrijker dan de techniek zijn de sociaal-economische en politieke omstandigheden waaronder duurzaam bosbeheer gestalte moet krijgen. Uit een overzicht van de sleutelfactoren voor succesvol bosbeheer kwam naar voren dat de belangrijkste voorwaarden voor duurzame houtwinning in het Braziliaanse Amazonegebied ontbreken. Vooral het ontbreken van een goede planning van het grond- en bosgebruik, een krachtige bosbouworganisatie en de politieke wil om het bos als ecosysteem voor de toekomst te bewaren, vormen belangrijke hindernissen voor duurzaam beheer van het Amazone-oerwoud. Als gevolg hiervan heeft zich in de laatste 30 jaar een grondgebruikpatroon ontwikkeld, waarvan een zeer vernietigende invloed uitgaat op het bos en de bevolkingsgroepen die daarvan afhankelijk zijn.

Samenvattend luiden onze conclusies ten aanzien van de ecologische gevolgen en de perspectieven voor duurzaam bosgebruik als volgt:

- De houtwinning hoort mede door het overheersen van kleinschalige houtkap en door de nauwe samenhang tussen houtwinning en ontginningen voor akkerbouw en veeteelt niet tot de belangrijkste oorzaken van ontbossing in het Braziliaanse Amazonegebied.
- Omdat de houtwinning in het Braziliaanse Amazonegebied eerder gevolg dan oorzaak is van de ontginningen, leidt het in veel mindere mate dan in andere gebieden tot openlegging van voorheen ontoegankelijk bos voor volgende landgebruikers.
- Hoewel duurzame houtwinning technisch gezien mogelijk is, wordt bosbeheer voor duurzame houtproduktie in het Braziliaanse Amazonegebied vooral belemmerd door de indirecte (eigendoms)relatie tussen houtbedrijven en grondstofbron, het goedkope aanbod van grondstoffen door ontginningen en door de algemene politieke en institutionele context.

Sociaal-economische aspecten

In hoofdstuk 6 onderzochten we de sociaal-economische betekenis van de houtsector. We belichtten daarbij vier aspecten. Het eerste aspect betrof de mate waarin de houtsector een bijdrage levert aan de basisbehoeften van de lokale bevolking. Vervolgens keken we naar de houtsector als een bron van werkgelegenheid en inkomen. Daarna zijn we ingegaan op conflicten tussen houtbedrijven en lokale bevolkingsgroepen, waarbij we een onderscheid

maakten tussen conflicten met dorpsgemeenschappen over het kappen in het hen omringende bos, conflicten over het kappen in indianenreservaten en conflicten over de eigendom van grond. We sloten het hoofdstuk af met de visie van diverse lokale sociale organisaties op de rol van de houtsector in de regionale ontwikkeling.

Uit hoofdstuk 6 kwam naar voren, dat het belangrijk is om ten aanzien van de sociaal-economische gevolgen een onderscheid te maken tussen de kleine houtzagerijen aan de ene kant en de grote ondernemingen aan de andere. De kleine houtzagerijen, die in aantal overheersen, maar in de totale produktie een geringe rol spelen, zijn in belangrijke mate geïntegreerd in de lokale economie. Hun produktie van timmerhout en hout voor boten en (landbouw)werktuigen is gericht op de consument in de naaste omgeving. Hun grondstoffen zijn voor het grootste deel afkomstig uit bossen die worden ontgonnen, zodat de schade aan primair bos en de daarin levende dieren minimaal is. In de kolonisatiegebieden levert de houtverwerking een extra bron van inkomsten voor de kleine boeren, die van de landbouw alleen nauwelijks kunnen rondkomen. De verkoop van bomen en gezaagd hout ondersteunt tevens de landbouwactiviteiten van deze kleine producenten.

Middelgrote en grote bedrijven spelen een veel belangrijkere rol als bron van werkgelegenheid. In de grote ondernemingen is daarbij ook plaats voor vrouwen, die vooral werkzaam zijn in de produktie van fineerplaat, multiplex en parket. De werkgelegenheid in de grote ondernemingen is ook veel stabieler dan in de kleine en middelgrote zagerijen, omdat deze bedrijven minder gevoelig zijn voor seizoenschommelingen in het aanbod van grondstoffen.

De winsten van de middelgrote en grote bedrijven worden over het algemeen in de regio zelf geherinvesteerd: zowel in de houtwinning als in andere economische activiteiten. Daarmee leveren deze bedrijven een niet onbelangrijke bijdrage aan de diversificatie van de regionale economie.

In andere opzichten is de aanwezigheid van grote houtbedrijven echter beduidend minder positief. Gemechaniseerde houtkap-operaties leiden tot vermindering van de wildstand, die een bron van vleesvoorziening is voor de lokale bevolking in het binnenland. Bovendien is de produktie van deze bedrijven vooral gericht op de markten in Zuid-Brazilië en in het buitenland. Door de betere winstmarges die elders zijn te realiseren, zijn de kwalitatief hoogwaardige hardhoutsoorten voor de lokale bevolking onbetaalbaar geworden.

De grote houtzagerijen en houtverwerkende industrieën vormen tevens een bron van conflict op diverse fronten. Bevolkingsgroepen in het binnenland (*caboclos*) verzetten zich steeds vaker tegen de aanwezigheid van houtbedrijven, omdat de activiteiten van deze bedrijven botsen met hun bestaanswijze (jacht, zwerflandbouw en het verzamelen van bosprodukten als vruchten, noten en rubber). Ook de inheemse bevolking wordt in haar bestaan en culturele identiteit bedreigd door de diverse manieren waarop houtbedrijven, legaal en illegaal, grondstoffen onttrekken aan indianenreservaten. Een derde groep van conflicten is die om betwist grondbezit. Houtbedrijven, die primair geïnteresseerd zijn in de grondstoffen, spelen daarbij vaak een indirecte rol, door het financieren van landkrakers (*posseiros*) in ruil voor het kappen van bomen. Verschillende bedrijven met grote stukken bos zijn evenwel ook rechtstreeks in grondconflicten betrokken. Dat is vaak het geval als ze land in bezit nemen dat al in gebruik was door bewoners van dorpen in het binnenland of waar zich al eerder kleine boeren hadden gevestigd. Ook doen zich grondconflicten voor, als kleine boeren zich vestigen in het door het houtbedrijf toegeëigende bos, dat niet duidelijk produktief wordt benut.

Een probleem dat los staat van de omvang van de bedrijven is het veelvuldig voorkomen van arbeidsongevallen en het veronachtzamen van de preventie ervan.

De lokale bevolking is - via de verschillende sociale organisaties - nooit betrokken geweest bij de beslissingen over de vestiging en ontwikkeling van de houtindustrie. We bespraken twee voorbeelden, waaruit bleek dat organisaties die lokale bevolkingsgroepen vertegenwoordigen een duidelijke visie hebben op de rol die de houtsector kan spelen in de regionale ontwikkeling. Uit de gepresenteerde voorstellen kwam naar voren, dat men zeker niet tegen de aanwezigheid van houtverwerkende bedrijven in het gebied is, mits (1) de houtexploitatie past in een breder kader van landgebruik-planning en bosbouwbeleid, (2) de houtwinning duurzaam is en gecontroleerd wordt, (3) de leefgebieden van de inheemse bevolking worden beschermd, (4) de produktie op de eerste plaats is gericht op de lokale behoeften en (5) de werknemers goede arbeidsomstandigheden en medezeggenschap in het beleid van de onderneming wordt gegarandeerd.

Samengevat luiden onze conclusies over de sociaal-economische betekenis van de houtsector in het Braziliaanse Amazonegebied als volgt:

- De houtindustrie kan een belangrijke rol spelen in de sociaal-economische ontwikkeling van het Amazonegebied. Er is een groeiende behoefte aan houtprodukten en werkgelegenheid. Bovendien kan de houtwinning en -verwerking agrarische activiteiten ondersteunen en leiden tot aanvullende investeringen in andere bedrijfstakken.
- In de huidige context vervult de houtindustrie deze rol in onvoldoende mate door het gebrek aan controle op met name de grote ondernemingen. Deze controle betreft zowel de houtkap als de arbeidsomstandigheden. In dit verband doet zich ook het gebrek aan een goede planning van het landgebruik gelden. Dit heeft tot gevolg dat de leefgebieden van indianen en andere lokale bevolkingsgroepen onvoldoende worden beschermd tegen illegale of onderbetaalde onttrekking van grondstoffen en leidt tot conflicten om het gebruik en bezit van de grond.

De houtsector in internationaal perspectief

De vierde en laatste onderzoeksvraag had betrekking op de betekenis van de houtsector op de nationale en internationale markt voor tropisch hardhout en de mogelijke invloed van handelsmaatregelen op de duurzaamheid van de houtkap. Deze vraag hebben we uitgewerkt in hoofdstuk 7. Daarin hebben we gezien dat ongeveer 90% van de totale houtproduktie uit het Amazonegebied op de binnenlandse markt wordt afgezet. Behalve het Amazonegebied zelf, zijn vooral het dichtbevolkte noord- en zuidoosten van Brazilië belangrijke afzetmarkten.

De buitenlandse markt is voor de onderzochte bedrijven belangrijker dan voor de houtsector in het Amazonegebied als geheel. De ligging van de afzetmarkten, de categorieën afnemers en de gebruikte afzetkanalen bleken te variëren met de produktieomvang van de bedrijven. Naarmate een bedrijf meer produceert nemen de lokale markt en particuliere afnemers voor de afzet in betekenis af, terwijl grootverbruikers (groothandel, houtverwerkende industrieën en bouwondernemingen) en de exportmarkt belangrijker worden.

Hardhout uit het Amazonegebied draagt slechts 0,7% bij aan de totale waarde van de Braziliaanse export. Op de wereldmarkt speelt hardhout uit het Amazonegebied geen rol van betekenis. Slechts een beperkt aantal houtsoorten, zoals mahonie (*Swietenia macrophylla*) en baboen (*Virola surinamensis*) vinden gemakkelijk aftrek. De belangrijkste uit Brazilië importerende landen zijn de Verenigde Staten, Engeland, Spanje, Italië en

enkele Caribische eilanden. 's Werelds hardhoutimporteur nummer één, Japan, is als afzetmarkt voor hardhout uit het Amazonegebied van geen enkele betekenis. Vooralsnog is niets te merken van een groter aandeel op de wereldmarkt als gevolg van de uitputting van regenwouden in Afrika en Zuidoost-Azië.

De ruime afzetmogelijkheden in het land zelf, de geringe betekenis van de hardhoutexporten voor de Braziliaanse handelsbalans en de marginale rol van Amazonehout op de wereldmarkt, maken het moeilijk om via de houthandel druk uit te oefenen op bedrijven om de houtwinningspraktijken te veranderen. In hoofdstuk 7 beschreven we twee - deels tegenover elkaar staande - initiatieven op dit terrein: de Internationale Tropisch Hout Organisatie (ITHO) en de campagnes om de import van hout uit niet duurzaam beheerde bossen te beperken.

We concludeerden dat maatregelen via de houthandel waarschijnlijk weinig effect zullen sorteren op de houtkappraktijken of op de ontbossing in het Amazonegebied. Voor een deel is dat toe te schrijven aan de kenmerken van de rondhoutvoorziening zelf (tussenpersonen, relatie houtwinning en ontginningen, te smalle winstmarges voor kleine zagerijen om bossen duurzaam te exploiteren). Voor een ander deel ligt dat aan het slechte functioneren van de Braziliaanse bosbouwdienst (IBAMA) die de houtbedrijven moet controleren. Tenslotte wezen we erop dat de belangrijkste oorzaken voor de ontbossing in het Amazonegebied buiten de houtsector liggen, namelijk bij landbouw en veeteelt, grootschalige mijnbouwprojekten en de bouw van waterkrachtcentrales.

Samengevat concludeerden we met betrekking tot de markt en het effect van handelsmaatregelen:

- De binnenlandse markt speelt een veel belangrijkere rol voor de houtsector in het Braziliaanse Amazonegebied dan de buitenlandse markt. Ook draagt Amazone-hout weinig bij aan de Braziliaanse deviezenopbrengst en heeft het een gering aandeel in de wereldmarkt voor hardhout. Deze factoren tezamen maken de houtsector weinig gevoelig voor druk die via de handel wordt uitgeoefend om het bos op duurzame wijze te exploiteren.
- Het effect van handelsmaatregelen op de houtkappraktijken in het Amazonegebied zal voorlopig beperkt zijn. Dat hangt in belangrijke mate samen met de kenmerken van de houtwinning. Bosbeheer is onaantrekkelijk of onmogelijk in gevallen dat (1) bos wordt geëxploiteerd dat

eigendom is van anderen, (2) hout wordt gekapt in bos dat plaats zal maken voor agrarische activiteiten, (3) stammen worden aangeleverd via tussenpersonen, (4) houtwinning wordt ondernomen als een nevenactiviteit en/of (5) de houtwinning en -verwerking te weinig winst oplevert om in duurzame exploitatie te kunnen investeren.
- Van maatregelen via de houthandel zal weinig effect uitgaan op de ontbossing in het Amazonegebied, omdat commerciële houtkap niet tot de belangrijkste oorzaken van die ontbossing gerekend kan worden.

De houtsector en de duurzame ontwikkeling van het Amazonegebied

De centrale vraag waar het in dit onderzoek om ging, was de bijdrage die de houtsector kan leveren aan de duurzame ontwikkeling van het Amazonegebied. Omdat het antwoord op deze vraag nauw samenhangt met dat wat men onder ontwikkeling verstaat, hebben we het begrip 'ontwikkeling' in hoofdstuk 1 gedefinieerd als een proces waarin (1) in toenemende mate in de basisbehoeften van een steeds grotere groep mensen wordt voorzien, (2) de ongelijkheden in inkomensverdeling en toegang tot hulpbronnen worden teruggebracht, (3) de meest kwetsbare bevolkingsgroepen meer greep en invloed krijgen op het ontwikkelingsproces waarvan ze deel uitmaken, en (4) de capaciteit van de aarde om ook in de toekomst in de basisbehoeften te voorzien in stand wordt gehouden.

Bovenstaande conclusies overziend, moeten we concluderen dat de houtsector in het Braziliaanse Amazonegebied bij de huidige stand van zaken in zeer beperkte mate bijdraagt aan de duurzame ontwikkeling van de regio. Alleen de kleine houtzagerijen zijn primair gericht op de lokale behoefte aan hout. De middelgrote en grote bedrijven, die meer dan 80% van de houtproduktie voor hun rekening nemen, produceren vooral voor consumenten elders in Brazilië en in het buitenland. Daardoor is kwalitatief hoogwaardig hout voor de meerderheid van de lokale bevolking in het Amazonegebied onbetaalbaar geworden. Bovendien heeft grootschalige houtkap een negatieve invloed op de wildstand, hetgeen ten koste gaat van bevolkingsgroepen die door de jacht in hun vleesbehoefte voorzien.

De houtindustrie is een belangrijke bron van werkgelegenheid en houtwinning betekent in veel gevallen een aanvullende bron van inkomsten voor kleine boeren. Als winsten opnieuw geïnvesteerd , is dat over het algemeen in het Amazonegebied zelf. Maar dit betekent niet dat de houtsector bijdraagt aan het verkleinen van de extreme inkomensverschillen

of van de ongelijkheden in de toegang tot natuurlijke hulpbronnen. De lonen zijn laag en de winsten van grote zagerijen en houtondernemingen komen vooral een kleine groep van ondernemers ten goede. De slechte arbeidsomstandigheden leiden tot een groot aantal arbeidsongevallen. De activiteiten van met name grote ondernemingen vormen in veel gevallen een bedreiging voor inheemse en andere bevolkingsgroepen die voor hun bestaan van het bos afhankelijk zijn. Ook zijn - vooral de grotere - houtbedrijven vaak betrokken in grondconflicten, waarvan landlozen en kleine boeren veelal het slachtoffer worden.

De ontwikkeling van de houtsector heeft er niet toe geleid dat arme bevolkingsgroepen meer invloed op het ontwikkelingsproces hebben gekregen. Beleidmakers en investeerders houden zelden rekening met de visie van sociale organisaties. Hun plannen om de bosbouw in het Amazonegebied te stimuleren en in de houtindustrie te investeren worden buiten de betrokken bevolking om, en vaak ook buiten het Amazonegebied ontwikkeld.

De houtexploitatie in het Amazonegebied is in haar huidige vorm geen duurzame activiteit. Er wordt nauwelijks geïnvesteerd in bosbeheer om de produktiecapaciteit van het bos voor de toekomst te bewaren. Deze investeringen hebben geen zin wanneer gebruik wordt gemaakt van bomen, die anders plaats zouden maken voor akkers of weidegrond. Maar ook daar waar bos primair om het hout wordt geëxploiteerd, wordt onzorgvuldig gekapt en worden zelden maatregelen getroffen om het herstel van het bos te garanderen.

Er zijn zeker mogelijkheden om de bijdrage van de houtindustrie aan de regionale ontwikkeling te vergroten. Maar wil ook sprake zijn van een ontwikkeling die de bevolking van het Amazonegebied ten goede komt en die duurzaam van aard is, dan zijn ingrijpende maatregelen nodig. Daarbij verdient het aanbeveling aandacht te besteden aan de volgende aspecten.

1. Duurzame houtwinning kan alleen worden gerealiseerd als deze een plaats krijgt in een goede planning van het land- en bosgebruik. Naast het aanwijzen van stukken bos voor duurzame houtproduktie, is het bij een dergelijke planning ook nodig om gebieden reserveren voor natuurbehoud en voor de exploitatie van andere (niet-hout) bosprodukten. De leefgebieden van de inheemse bevolking moeten effectief worden afgebakend en beschermd - ook tegen illegale of voor de indianen onvoordelige houtkap. Daarnaast verdient het aanbeveling bij

zo'n planning rekening te houden met aanspraken op landbouwgrond, mijnbouw en andere vormen van landgebruik die een aanslag doen op het bos. Zaak is deze vormen van landgebruik zo te plannen dat ze plaatsvinden in die delen van het Amazonegebied, die daarvoor op grond van de bodemvruchtbaarheid of andere natuurlijke omstandigheden het meest geschikt zijn.

2. Bij het plannen van landgebruik zoals hierboven omschreven, moet er rekening mee worden gehouden dat het Amazonegebied geen 'lege ruimte' is. Door het ontbreken van een dergelijke planning toen het Amazonegebied werd opengelegd, is reeds een breed scala van activiteiten en sociale groepen ontstaan die vaak met elkaar in conflict zijn. Om verdere escalatie van deze conflicten te voorkomen is het noodzakelijk om de betrokken bevolkingsgroepen nauw bij de planning te betrekken. Ook vereist de gegroeide situatie een krachtig beleid om de ontstane conflicten op te lossen.
3. Duurzame houtwinning en duurzame ontwikkeling van het Amazonegebied in het algemeen vragen ook om maatregelen buiten het Amazonegebied. Voorkomen moet worden dat sociale problemen elders in Brazilië de migratie van landloze boeren en de verplaatsing van sociale problemen naar het Amazonegebied tot gevolg hebben. Dit vereist een krachtig nationaal landbouwbeleid, dat een eind maakt aan extreme verschillen in grondbezit en meer steun geeft aan kleine boeren.
4. Bij het ontwikkelen van een beleid specifiek gericht op de houtsector is het raadzaam rekening te houden met belangrijke verschillen tussen de meerderheid van de kleine houtzagerijen aan de ene kant, en de grote bedrijven aan de andere. Kleine houtzagerijen kunnen een belangrijke rol vervullen in de regionale economie, door hun gerichtheid op de lokale vraag, het benutten van hout dat afkomstig is van ontginningen en de verbreding van de bestaansbasis van kleine boeren. Grote ondernemingen moeten veel strenger worden gecontroleerd op illegale houtwinning, hun betrokkenheid in grondconflicten en op het nakomen van hun verplichting tot duurzaam bosbeheer.
5. Om het grote aantal arbeidsongevallen in de houtsector terug te brengen is het gewenst meer aandacht te besteden aan de preventie van deze ongevallen. Dat vraagt om betere arbeidsomstandigheden, betere voorlichting op de werkplek over het zorgvuldig gebruik van machines en beschermende kleding.

6. Het Amazonegebied heeft een krachtige en goed georganiseerde bosbouwdienst nodig, met voldoende menskracht, materieel en geld om haar controlerende taak naar behoren te kunnen uitvoeren.
7. Strengere controle en zwaardere straffen zijn nodig ter bestrijding van de illegale exploitatie van natuur- en indianenreservaten.
8. Onderzoek naar methoden voor duurzame houtwinning, die zijn aangepast aan de omstandigheden van het Amazonegebied, verdient meer steun. Daarnaast zou het goed zijn meer aandacht te besteden aan het bekend en toegankelijk maken van de resultaten van dit onderzoek bij beleidmakers en houtondernemers.
9. Tenslotte verdient het aanbeveling om initiatieven te stimuleren, die erop zijn gericht het bos te behouden en/of op duurzame wijze te exploiteren. Te denken valt aan belastingvoordelen of andere financiële prikkels voor het handhaven, beschermen of beheren van bos.

Resumo e conclusões

O presente estudo pretende descrever as características geográficas, econômicas e sociais do setor madeireiro da Amazônia brasileira e analisar os efeitos sociais, econômicos e ecológicos da exploração madeireira. A principal questão foi entender como a exploração e o processamento de madeira contribuem ao desenvolvimento sustentável da região amazônica. Esta questão principal foi subdividida em quatro pontos de observação:

1. Quais as formas de exploração madeireira na região Amazônica, quais as suas características econômicas e sociais e como estas foram influenciadas por processos planejados ou espontâneos?
2. Quais as formas de suprimento de toras na Amazônia brasileira, quais as consequências ecológicas da extração de madeira e quais as perspectivas para métodos de extração sustentáveis?
3. Como contribui o setor madeireiro ao desenvolvimento social e econômico e à incorporação da região na economia nacional e internacional?
4. Qual é a relação entre a evolução do setor madeireiro amazônico e o mercado nacional e internacional de madeiras de lei tropicais, e qual é o efeito potencial de medidas restritivas no mercado internacional com relação às madeiras provenientes de florestas não manejadas de uma forma sustentável?

Após a recapitulação metodológica, seguem abaixo os principais resultados do presente estudo.

Metodologia

A pesquisa foi realizada na região de Santarém, na parte ocidental do estado do Pará. Esta região tem uma área de aproximadamente 30.000 quilômetros quadrados nos municípios de Santarém, Rurópolis e Uruará, ao sul do rio Amazonas e ao norte da Transamazônica. O que determinou a escolha desta região foi o fato da cidade de Santarém ser um dos centros tradicionais de processamento de madeira, numa área onde recentemente muitas serrarias têm se estabelecido, como consequência da abertura da região. Este aspecto possibilitou pesquisar não só as formas tradicionais de exploração de madeira, como também os resultados do recente processo de colonização.

Em 1989 a região contava com cerca de 60 serrarias, localizadas na cidade de Santarém e ao longo das três maiores estradas que cruzam a região (a Transamazônica e as estradas de Santarém a Cuiabá e de Santarém a Curua Una).

Todas as serrarias foram entrevistadas, proporcionando aspectos relativos a sua localização, fontes de matéria prima, fornecimento de toras, criação de empregos, processo de seleção de empregados, produção e seu destino, equipamento, a relação com entidades governamentais e aspectos econômicos da produção.

Pelo fato da região em estudo não ter empresas de grande porte, foram incluídas no levantamento 11 empresas de grande porte localizadas em Belém.

Para obter informação mais detalhada sobre as condições de trabalho e as características da mão-de-obra, foram entrevistados 60 trabalhadores na indústria madeireira. Também foram entrevistados nove madeireiros autônomos ativos na extração, transportação e venda de madeira roliça. Para completar o quadro das consequências sociais da exploração madeireira, foram também entrevistados representantes de organizações sociais como sindicatos, grupos ambientalistas e outras organizações populares.

Na etapa final do trabalho de campo foram observadas várias explorações em diferentes escalas e níveis tecnológicos. Foram observados o número de trabalhadores; a organização e divisão do trabalho, a produtividade, os danos à vegetação, as condições de alimentação e alojamento dos trabalhadores, e os riscos de acidentes de trabalho.

Na elaboração dos dados também foram consultados estudos relativos a outras partes da Amazônia, como forma de comparar os resultados da presente pesquisa com os resultados de pesquisas realizadas em outras áreas. Informação complementar e material de fundo foi coletada na forma de relatórios governamentais, relatórios de pesquisas e teses não publicadas, publicações estatísticas, documentos de organizações não governamentais e recortes de artigos de jornais.

A primeira questão da pesquisa, relativa às diferentes formas e características de exploração madeireira e aos processos dirigidos e espontâneos que têm influenciado na expansão do setor madeireiro, foi elaborada nos capítulos 2, 3 e 4.

No capítulo 2 a expansão do setor madeireiro foi colocada no contexto de processos planejados e espontâneos a nível nacional. Desde o inicio deste século, a indústria madeireira se localizou em regiões mais desenvolvidas, particularmente no sul, perto das florestas de pinheiro do Paraná (*Araucaria angustifolia*). Como resultado do esgotamento dessas florestas, a crescente escassez de matéria prima criou a necessidade de abrir novas fontes de madeira roliça.

A Amazônia tornou-se uma opção de deslocamento, como consequência da forte política governamental nos anos 60 e 70 em abrir a região e integrá-la na economia nacional. As novas estradas colocaram a disposição estoques de madeira previamente inacessíveis, e estabeleceram uma ligação entre as fontes ricas em madeira de lei tropical e os centros de consumo e processamento de madeira nas outras partes do país. A tradicional escassez de mão-de-obra na Amazônia foi aliviada pela migração, dirigida e espontânea. Grandes áreas podiam ser obtidas a preços baixos, e grandes empresas podiam aproveitar-se de incentivos fiscais, caso investissem capital na região Amazônica. A derrubada da floresta para fins agropecuários resultou num forte aumento da oferta de madeira roliça nas áreas de colonização.

As tentativas de promover o desenvolvimento do setor madeireiro têm tido pouco êxito. Porém, os inventários e pesquisas realizadas resultaram num conhecimento maior do potencial madeireiro da floresta, e das características e utilidade de espécies de madeira antes pouco conhecidas.

O capítulo 3 contém uma descrição das características do setor madeireiro na Amazônia. Essas características refletem claramente o contexto da abertura e ocupação da região Amazônica. Tradicionalmente, a extração de madeira realizava-se nas florestas de várzea acessíveis pelos rios, e o processamento de madeira concentrava-se nas cidades de Belém, Manáus e, em escala menor, em Santarém. Com a construção das estradas e a derrubada de grandes áreas de floresta, a exploração de madeira deslocou-se dos grandes centros urbanos para as regiões de colonização. Os maiores núcleos de extração e processamento de madeira podem ser

atualmente encontrados ao longo das estradas construídas nas décadas passadas nas regiões ocupadas recentemente. É o caso do sul do Pará, o norte do Mato Grosso e o estado de Rondônia. A maioria dos proprietários de serrarias são provenientes de outras partes do Brasil: principalmente do sul, mais também do nordeste.

O setor madeireiro da Amazônia é caracterizado pelos milhares de pequenas serrarias espalhadas por toda a região. São as pequenas serrarias das áreas rurais as que estão particularmente vinculadas ao processo de colonização. Em geral, se estabeleceram recentemente, e serão abandonadas em poucos anos. Funcionam freqüentemente como atividade complementar junto à agricultura, aproveitando-se da oferta de madeira das árvores derrubadas no próprio terreno ou no dos vizinhos. O processamento de madeira se dá de forma simples, sendo pranchas e tábuas os produtos mais comuns. O equipamento é simples e obsoleto. A produção é interrompida quando as estradas tornam-se intransitáveis na época de chuvas, e por falta de capital para formar estoques de toras. O volume da produção raramente ultrapassa 500 m^3 por ano.

As pequenas serrarias na cidade de Santarém também processam madeira proveniente de florestas transformadas em roças. As toras lhes são fornecidas por terceiros: extratores autónomos, denominados madeireiros ou toreiros. Em total, mais de dois terços das serrarias na região estudada pertencem à categoria de pequenas serrarias. Porém, a produção total dessas serrarias não ultrapassa os 16% da produção total de madeira na região de Santarém.

Com exeção de algumas serrarias de médio porte localizadas nas áreas rurais, as serrarias de maior porte que foram instaladas basicamente como indústrias madeireiras, encontram-se nas cidades. Os produtos dessas serrarias apresentam maior acabamento e maior qualidade. Embora o volume da produção das serrarias maiores é ainda considerado baixo, este é consideravelmente superior à produção das serrarias pequenas. As serrarias de médio porte produzem uma média de 1000 m^3 de madeira serrada por ano, enquanto que a produção média anual das serrarias de grande porte corresponde a mais de 3.400 m^3. Na região estudada, 22% das empresas pertencem ao grupo de serrarias de médio porte com uma produção entre 500 e 2.500 m^3 por ano. Apenas 7% das empresas são serrarias de grande porte, com uma produção entre 2.500 e 5.000 m^3 por ano. A contribuição à produção total na região de Santarém das duas categorias é de 27% e 29%, respectivamente.

Uma quarta categoria de empresas é constituída pelas grandes companhias madeireiras. Essas companhias têm pouco em comum com as empresas menores, no que diz respeito ao tipo de produtos (parquete, laminados, compensados), e ao volume da produção (mais de 5.000 m^3 por ano). Embora sejam uma minoria, sua influência é muito mais forte do que a das outras, devido à escala maior em que operam. Essas grandes companhias absorvem parte da produção das serrarias menores, as quais encontram, desta forma, um caminho para o mercado de exportação. Na região estudada apenas uma empresa pertence à categoria de companhias grandes. Não obstante, só essa empresa produz uma quarta parte da produção total da região de Santarém.

As diversas formas de suprimento de toras às serrarias foram analisadas no capítulo 4. Foi concluído que apenas um número reduzido de espécies é utilizado, sendo estas principalmente o mogno (*Swietenia macrophylla*) e a virola (*Virola* spp.) na Amazônia como todo. Descrevemos neste capítulo diversas formas de extração, diferindo em escala e nível tecnológico. A distinção entre as florestas periodicamente inundadas (várzea) e as de terra firme, veio a ser decisiva no que diz respeito à organização do processo de extração, os instrumentos usados e a forma de transportar as toras.

As florestas de várzea são geralmente terras devolutas em áreas exclusivamente acessíveis pelo rio. Nessas florestas prevalecem métodos de extração tradicionais. A maior parte do trabalho é realizado manualmente, e as toras são transportadas pela água, em jangadas ou por balsa. Os extratores são autônomos, mas recebem previamente do comprador das toras os instrumentos de trabalho e comida. Por isso, a relação entre os extratores e o comprador - a serraria ou um comerciante intermediário - é muito parecida com a tradicional relação de dívida entre o seringueiro e o seringalista na economia da borracha, conhecido como o sistema do aviamento. As empresas pesquisadas em Belém obtêm 48% da sua matéria prima de madeireiros trabalhando em florestas de várzea.

As florestas de terra firme são exploradas onde são acessíveis pelas estradas. Em geral, estes trechos de florestas pertencem a colonos ou fazendeiros, embora algumas explorações ocorram também nas terras devolutas, em regiões mais isoladas. As condições nas florestas de terra firme permitem a utilização de máquinas pesadas. O seu uso depende do tipo de agente. Observou-se que muitas serrarias não se ocupam da extração, comprando as toras de extratores autônomos. Os madeireiros

operam em menor escala, utilizando moto-serra, terçado e caminhão madeireiro equipado com guincho (catraca) para carregar as toras. Também as serrarias de pequeno porte nas áreas de colonização trabalham desta forma. As árvores são derrubadas em trechos de floresta onde o colono - sendo freqüentemente o próprio madeireiro o dono da serraria - pretende fazer a roça. Vinte e três por cento das serrarias pesquisadas trabalham desta forma.

As serrarias de médio porte, que se dedicam à extração, operam numa escala um pouco maior, já que geralmente utilizam uma máquina a mais, além da moto-serra e do caminhão madeireiro. Nas áreas de colonização, onde a agricultura e a exploração de madeira estão intimamente ligadas, é geralmente utilizado um trator para a retirada da madeira. As serrarias da cidade que operam neste nível intermediário usam freqüentemente um trator de esteira ou um carregadeira. Vinte e um por cento das serrarias pesquisadas trabalham neste nível intermediário.

No caso de explorações mecanizadas de escala maior, emprega-se toda maquinaria disponível (trator de esteira, carregadeira, skidder). Nesta escala e nível tecnológico, existe uma rigorosa divisão de trabalho entre os operários. Somente algumas poucas companhias grandes (14% das empresas pesquisadas) trabalham nesta escala. Essas operações ocorrem parcialmente em floresta virgem. Porém, as operações em grande escala estão ligadas também às derrubadas, através de contratos de exploração entre companhias madeireiras e fazendeiros que pretendem transformar a floresta em pastagem.

Quarenta e duas das serrarias pesquisadas dependem totalmente de terceiros no suprimento de sua matéria prima. Porém, as serrarias que empregam sua própria turma de extração, obtêm parte das toras utilizadas também de terceiros. Em total, 80% das toras utilizadas pelas serrarias pesquisadas provêem de madeireiros não diretamente empregados.

As conclusões a respeito da primeira questão podem ser resumidas da seguinte forma:

- Nos últimos 30 anos uma nova forma de exploração de madeira surgiu na Amazônia brasileira, intimamente ligada à colonização da região e às derrubadas para fins agropecuários. Isso resultou num forte aumento do número de serrarias predominantemente pequenas em áreas que foram abertas e cultivadas.

- Em adição, a abertura de novos estoques de madeira atraiu companhias grandes do sul do Brasil, onde a matéria prima tornou-se progressivamente escassa. Até certo ponto, o deslocamento dessas companhias também foi estimulado pelos incentivos fiscais oferecidos às grandes empresas que investiram na região amazônica. Essas companhias de grande porte encontram-se principalmente nas cidades.
- No processo de extração predomina a derrubada em pequena escala, na qual madeireiros autônomos jogam um papel fundamental. Nessas operações de pequeno porte ainda ocorrem as formas tradicionais de exploração madeireira e as relações de trabalho a elas associadas.
- A relação que as serrarias têm com a fonte de matéria prima é freqüentemente indireta: elas não se ocupam do processo de extração ou exploram florestas pertencentes a outros. Ambas situações são pouco conducentes para a aplicação de métodos de extração sustentáveis.

Consequências ecológicas e perspectivas para um manejo florestal sustentável

A segunda questão da pesquisa, relativa às consequências ecológicas da extração e às perspectivas para a aplicação de métodos sustentáveis, foi tradada no capítulo 5. Uma revisão bibliográfica sobre os impactos ecológicos da exploração mecanizada de madeira, mostrou que extraindo somente uma pequena percentagem de árvores por hectare, um quarto até a metade das árvores remanescentes na floresta são danificadas. Além disso, operações mecanizadas resultam numa redução da diversidade de espécies vegetais e animais, numa perda de recursos genéticos, na erosão e compactação do solo, e aumentam a susceptibilidade da floresta a incêndios.

O impacto da exploração seletiva sem uso de maquinária pesada é consideravelmente menor. Neste caso, a exploração resulta também na crescente escassez de espécies de madeira mais valiosas, porém os danos nas árvores remanescentes são expressivamente menores (aproximadamente 10%), e não foram percebidos impactos na fauna.

Foi estimado que exploram-se na Amazônia 10.000 quilómetros quadrados de floresta por ano. Não obstante, por causa da predominação de operações em pequena escala e da ligação entre a exploração e as derrubadas para a implantação de roças e pastagens, a exploração madeireira não pode ser considerada uma das maiores causas do desmatamento na Amazônia brasileira. O desmatamento na Amazônia

brasileira está basicamente ligado à implantação de grandes fazendas de gado, na transformação da floresta em roças e na construção de estradas, hidrelétricas e grandes projetos de exploração dos recursos naturais.

Frente à expectiva das grandes operações mecanizadas ganharem importância num futuro próximo, o desenvolvimento de métodos de extração sustentáveis é de grande importância. Com base na pesquisa bibliográfica, foi concluído que a extração sustentável é tecnicamente factível, embora seja preciso continuar as pesquisas para adaptar sistemas existentes às condições específicas da Amazônia.

Mais importante ainda são as condições sociais, econômicas e políticas nas quais o manejo florestal sustentado tem que se basear. Uma revisão da bibliografia que trata dos elementos chaves para o bom êxito do manejo florestal, mostrou que não existem condições básicas para a exploração sustentável de madeira na Amazônia brasileira. Especialmente a falta de um zoneamento ecológico-econômico, o fraco serviço florestal e a falta da vontade política de preservar a floresta como ecossistema para o futuro, são obstáculos sérios para o manejo sustentável da floresta amazônica. Como consequência, surgiu nos últimos 30 anos um padrão de ocupação que é altamente destructivo para a floresta e os povos que dela dependem para sua subsistência.

Somando, o seguinte pode ser concluído a respeito das consequências ecológicas e das perspectivas para o uso florestal sustentável:

- A exploração de madeira não é uma das maiores causas do desmatamento na Amazônia brasileira, entre outras por causa da predominância de explorações em pequena escala e da íntima ligação entre a exploração de madeira e as derrubadas para fins agropecuários.
- A exploração de madeira na Amazônia brasileira é mais consequência do que causa de derrubadas. Este fato vem a contrastar com as formas de ocupação predominantes em outras regiões de floresta tropical, onde a exploração madeireira possibilita o assentamento posterior de colonos ou fazendeiros em áreas previamente inacessíveis.
- Embora o manejo sustentável é tecnicamente factível, existem sérias barreiras para realizar uma produção sustentável na Amazônia brasileira. Esses obstáculos são basicamente a relação indireta entre a serraria e a fonte de matéria prima, a oferta barata de toras proveniente das derrubadas, além do contexto político e institucional onde ocorre o processo.

Aspectos socio-econômicos

A importância social e econômica do setor madeireiro foi analisada no capítulo 6. Foram associados a esta questão quatro aspectos. O primeiro diz respeito ao papel do setor madeireiro em atender às necessidades básicas da população local. No seguinte, o setor madeireiro foi analisado como fonte de emprego e de renda. Subseqüentemente, foram considerados os conflitos entre empresas madeireiras e a população local, distinguindo entre conflitos pelo uso da floresta com as comunidades no interior, conflitos com povos indígenas pela extração de madeira em suas terras, e conflitos pela terra. Nós concluímos o capítulo com a apresentação das opiniões de diversas organizações sociais na região, relativas ao papel do setor madeireiro no desenvolvimento regional.

A respeito das consequências sociais e econômicas do setor madeireiro, surgiu do capítulo 6 que é importante distinguir as serrarias de pequeno porte das grandes empresas madeireiras. As serrarias de pequeno porte, que são maiores em número mas jogam um papel secundário na produção total, são muito mais integradas na economia local. Sua produção de madeira de construção, madeira para barcos e utensílios para a agricultura, é orientada para consumidores locais. A maior parte da matéria prima por elas utilizadas provêem de derrubadas, de modo que os danos na floresta primária e na fauna são mínimos. O processamento de madeira nas áreas de colonização significa uma fonte de renda adicional para os colonos, os quais mal sobrevivem da agricultura. A venda de árvores em pé ou de madeira serrada também favorece a ativade agrícola desses pequenos produtores.

Empresas de médio e grande porte jogam um papel importante na geração de emprego. As empresas grandes oferecem emprego também às mulheres, especialmente na produção de laminados, compensados e parquete. O emprego nas empresas grandes é mais estável do que nas serrarias de pequeno e médio porte, por serem menos susceptíveis às flutuações sazonais no suprimento de toras.

As serrarias de médio e grande porte em geral investem seus lucros dentro da região: tanto no setor madeireiro como em outras atividades econômicas. Neste sentido, estas empresas contribuem decisivamente à diversificação da economia.

A presença de empresas grandes é muito menos positiva sob outros pontos de vista. A extração mecanizada tem impactos negativos na caça,

fonte de proteina para a população do interior. Além disso, a produção destas empresas é principalmente orientada para o mercado no sul do Brasil e no exterior. Como consequência das maiores margens de lucro que podem ser alcançadas em outros lugares, a madeira de lei de primeira qualidade atualmente é cara demais para a população local.

As serrarias de grande porte e as grandes empresas madeireiras também constituem uma fonte de conflitos em vários aspectos. A população no interior (caboclos) opõem-se de modo crescente à presença das empresas grandes, já que as atividades dessas empresas afetam seus meios de existência (caça, agricultura itinerante e a extração de produtos florestais não madeireiros como frutas, castanhas e latex). As diversas estratégias - legais e ilegais - das empresas madeireiras para extrair madeira de reservas indígenas, constituem uma das ameaças principais ao meio de vida e identidade cultural dos índios. Um terceiro grupo de conflitos diz respeito aos títulos da terra. Empresas madeireiras que estão basicamente interessadas nos recursos florestais, geralmente tem um papel indireto nos conflitos pela terra, financiando os posseiros em troca de árvores. Não obstante, várias empresas madeireiras possuidores de grandes áreas de floresta também estão envolvidas diretamente em conflitos pela terra. Este é freqüentemente o caso quando estas tomam posse de uma área que já foi utilizada por moradores de comunidades no interior ou onde já houve assentamento de agricultores. Conflitos pela terra também surgem quando agricultores invadem uma área já apropriada por uma empresa madeireira, mas não evidentemente utilizada produtivamente por esta.

Um problema independente da escala em que operam as empresas é a ocorrência frequente de acidentes de trabalho e negligência de medidas preventivas.

A população local - através das suas organizações sociais - nunca foi envolvida nas decisões relativas ao estabelecimento e desenvolvimento de indústrias madeireiras. Foram discutidos dois exemplos mostrando que organizações que representam o povo da região têm idéias claras sobre o papel do setor madeireiro no desenvolvimento da região amazônica. As propostas apresentadas mostram que essas organizações não são contra a presença na região de empresas de processamento de madeira, desde que: (1) a exploração de madeira faça parte de um zoneamento econômico-ecológico e de uma política florestal para a Amazônia, (2) a exploração seja sustentável e estritamente controlada, (3) as áreas indígenas sejam protegidas efetivamente, (4) a produção seja orientada fundamentalmente

para as necessidades locais e (5) os trabalhadores tenham condições de trabalho decentes e possam participar na gestão da empresa.

Em suma, concluímos os seguintes pontos a respeito da importância social e econômica do setor madeireiro da Amazônia:

- O setor madeireiro pode desempenhar um papel importante no desenvolvimento social e econômico da região amazônica. A procura de produtos madeireiros e emprego é crescente. Além disso, a extração e processamento de madeira podem apoiar atividades agrícolas e podem induzir investimentos adicionais em outros setores econômicos.
- No contexto atual, o setor madeireiro desenvolve este papel de modo insuficiente, em particular pela deficiência da fiscalização nas grandes empresas. Esta fiscalização refere-se tanto à extração como às condições de trabalho. A esse respeito, colabora também a ausência de uma política de ocupação do solo. Esta falta resulta numa proteção inadequada aos povos indígenas e outras populações locais, contra a exploração ilegal e a subvalorização de recursos florestais, como também conduz a conflitos pela terra e pelo uso da floresta.

O setor madeireiro em perspectiva internacional

A quarta e última questão diz respeito à atuação do setor madeireiro no mercado nacional e internacional de madeira tropical de lei, e os possíveis efeitos de intervenções no comércio internacional em tornar a extração comercial de madeira mais sustentável. Esta questão foi elaborada no capítulo 7, no qual foi demonstrado que aproximadamente 90% da produção total da Amazônia é vendida no mercado interno. Além da região amazônica, os principais mercados estão localizados nos densamente povoados sudeste e nordeste do Brasil.

O mercado internacional é mais importante para as empresas pesquisadas do que para o setor madeireiro da Amazônia como todo. Também foi observado que a localização dos mercados, as categorias de compradores e os canais de distribuição, variam de acordo com o volume da produção das empresas. Já que as empresas produzem em grande escala, o mercado local e consumidores individuais tornam-se menos importantes no consumo da produção, enquanto que os consumidores comerciais e profissionais (atacadistas, indústrias beneficiadoras de madeira e empresas de construção) e o mercado externo assomem maior importância.

A madeira de lei da Amazônia representa apenas 0.7% do valor total das exportações brasileiras. No comércio internacional, as madeiras amazônicas desempenham um papel insignificante. Apenas um número reduzido de espécies, como o mogno (*Swietenia macrophylla*) e a virola (*Virola* spp.), são facilmente aceitas. Para o Brasil, os principais mercados externos são os Estados Unidos, o Reino Unido, a Espanha, a Itália, e algumas ilhas caribenhas. Japão, o maior importador de madeira de lei tropical do mundo, não tem importância alguma na exportação da madeira amazônica. Até agora, nenhum efeito é perceptível em termos de uma maior participação no comércio internacional, como resultado do esgotamento de florestas da África e Ásia Sudeste.

O grande potencial do mercado interno, a pouca importância das exportações de madeira para o balanço de pagamentos do Brasil, e o papel marginal das madeiras amazônicas no mercado internacional, tornam difícil o incentivo às empresas madeireiras a mudarem suas práticas de extração. No capítulo 7, descrevemos duas - em parte contrastantes - iniciativas a este respeito: a Organização Internacional de Madeiras Tropicais (ITTO), e as campanhas para limitar as importações de madeira proveniente de florestas não manejadas de forma sustentável.

Foi concluído que as intervenções no comércio internacional provavelmente terão pouca influência nas práticas de extração ou no desmatamento na Amazônia. Isto em parte pode ser atribuído às próprias características da exploração de madeira: o suprimento de toras através de terceiros, a ligação entre a exploração de madeira e as derrubadas para fins agropecuários, e as pequenas margens de lucro das serrarias de pequeno porte, as quais não permitem investimentos em manejo florestal. Por outra parte, as práticas de extração existentes são também consequência do mal-funcionamento do serviço florestal brasileiro, o IBAMA, que é responsável pela fiscalização das empresas madeireiras. Finalmente, salientamos que as principais causas do desmatamento na Amazônia brasileira estão fora do setor madeireiro, sendo estas a expansão de atividades agropecuárias, os grandes projetos de mineração e exploração de recursos naturais e a construção de hidrelétricas.

Resumido, foi concluído a respeito do comércio e o efeito de medidas de mercado:

- Para o setor madeireiro da Amazônia brasileira o mercado interno é mais importante do que o mercado externo. As madeiras amazônicas

contribuem pouco aos rendimentos da exportação e participam marginalmente no comércio internacional. A combinação desses fatores fazem com que o setor madeireiro seja pouco susceptível à pressão do comércio em explorar a floresta de uma forma sustentável.

- O efeito de medidas mercadológicas nas práticas de exploração na Amazônia será, por enquanto, limitado. Isto pode ser explicado, em grande parte, pelas características da atual exploração florestal. O manejo florestal é impossível ou pouco atrativo, caso: (1) a floresta explorada seja propriedade de outros, (2) a floresta explorada seja derrubada para atividades agropecuárias, (3) as toras sejam fornecidas por terceiros, (4) a exploração de madeira seja empreendida como atividade econômica complementar e/ou (5) a extração e processamento de madeira renda lucros insuficientes para investir em exploração florestal sustentável.
- Medidas no comércio internacional de madeira pouco influenciarão no desmatamento da Amazônia, porque a extração comercial de madeira não faz parte das causas principais do desflorestamento na Amazônia.

O setor madeireiro e o desenvolvimento sustentável da região amazônica

A questão principal deste estudo diz respeito à possível contribuição do setor madeireiro no desenvolvimento sustentável da região Amazônica. A resposta a esta questão está intimamente ligada à concepção do desenvolvimento. No capítulo 1, o conceito de desenvolvimento foi definido como um processo envolvendo: (1) uma maior disponibilidade de bens e serviços básicos para uma maior parcela da população, (2) uma maior distribuição da renda e/ou um maior acesso à terra e outros recursos, pelos pobres, (3) uma crescente capacidade dos pobres em controlar e influenciar no processo de desenvolvimento do qual fazem parte, e (4) a manutenção da capacidade do mundo em atender às necessidades básicas no futuro.

Repassando as conclusões acima mencionadas, conclue-se que o setor madeireiro na região amazônica contribui apenas até certo ponto ao desenvolvimento sustentável da Amazônia. Somente as serrarias de pequeno porte estão orientadas para as necessidades locais de madeira. As empresas maiores dirigem sua produção principalmente para consumidores em outras partes do Brasil e do exterior. Conseqüentemente, a madeira de primeira qualidade tornou-se cara demais para a maioria do povo amazônico. Além disso, as operações de extração em grande escala têm uma influência

desfavorável na fauna, prejudicando a população que depende da caça para o consumo de carne.

O setor madeireiro é uma fonte de emprego importante, e a exploração madeireira freqüentemente representa uma fonte de renda adicional para os colonos. Os lucros são geralmente reinvestidos dentro da própria região amazônica. Porém, isto não significa que o setor madeireiro contribui à redução das grandes disparidades na renda ou no acesso a recursos naturais. Os salários são baixos e os lucros das serrarias e empresas madeireiras beneficiam apenas um grupo reduzido de empresários. As más condições de trabalho resultam em grandes números de acidentes. As atividades das grandes empresas, em particular, representam uma ameaça para os povos indígenas e outras populações que dependem da floresta para seu sustento. Especialmente as grandes empresas estão freqüentemente envolvidas em conflitos pela terra, nos quais os sem-terra e os pequenos produtores são muitas vezes as vítimas.

O desenvolvimento do setor madeireiro não resultou num aumento da influência dos pobres no processo de desenvolvimento. Planejadores e empresários raramente consideram as opiniões das organizações sociais. Seus planos para estimular o setor florestal da Amazônia, ou para investir no setor madeireiro, geralmente são esboçados fora a região amazônica, sem consultar a população local.

Nas atuais condições, a exploração de madeira na Amazônia não é sustentável. São raros os investimentos em manejo florestal para manter a capacidade de produção da floresta no futuro. Estes investimentos têm pouco sentido no caso de utilização de árvores que serão fatalmente derrubadas para fazer roça ou pastagem. Mas também quando a floresta é basicamente explorada em função da madeira, são raras as medidas necessárias para garantir a regeneração da floresta.

Há certamente oportunidades para que aumente a contribuição do setor madeireiro no desenvolvimento regional. Mas precisa-se de medidas drásticas para assegurar que este desenvolvimento beneficie a população local e que seja sustentável. Neste contexto, é recomendável deter-se nos seguintes aspectos:

1. A exploração sustentável de madeira somente pode ser realizada se for baseada num planejamento sensato do uso da terra e da floresta. Além de designar áreas para a exploração de madeira, é importante que tal zoneamento também reserve áreas florestais para fins de preservação, e

para a exploração de produtos florestais não-madeireiros. Áreas indígenas precisam ser efetivamente demarcadas e protegidas, também contra a extração ilegal de madeira e contra a venda desta em termos desfavoráveis para os índios. Além disso, é recomendável que o planejamento do uso do solo inclua restrições com relação ao uso da terra e da floresta, tais como a agricultura e a mineração. É importante planejar essas atividades de tal modo que elas ocorram em áreas amazonenses mais apropriadas, de acordo com a fertilidade do solo e outras condições naturais.

2. Quando o uso do solo seja planejado no sentido acima mencionado, é necessário considerar que a região Amazônica não é um 'espaço vazio'. Como resultado da ausência de tal planejamento desde o inicio da abertura da região amazônica, existe hoje uma grande variedade de grupos sociais e usos da terra, a muide conflitantes entre si. A fim de prevenir o crescimento destes conflitos, é preciso incluir as camadas da população afetadas, no processo de planejamento. A situação, da forma como se desenvolveu, requer uma política firme para resolver os conflitos dela resultantes.
3. A exploração sustentável da madeira e o desenvolvimento sustentável da região Amazônica em geral também requerem medidas a serem tomadas fora da região Amazônica. É preciso prevenir que os problemas sociais de outras regiões brasileiras resultem na migração de pequenos produtores em busca da terra e no deslocamento de problemas sociais para a região amazônica. Isto requer uma política agrícola decisiva a nível nacional, que resolva as disparidades extremas na posse de terra e ofereça mais apoio aos pequenos produtores agrícolas.
4. No desenho de uma política especificamente orientada para o desenvolvimento do setor madeireiro, é recomendável levar em conta as consideráveis diferenças entre a maioria de serrarias de pequeno porte e as grandes empresas. As serrarias de pequeno porte podem desempenhar um papel importante na economia regional, pelo fato de estar orientadas para o mercado local, por utilizarem madeira proveniente de derrubadas para fins agrícolas, e por estarem ampliando a base de subsistência para pequenos produtores agrícolas. As grandes empresas devem ser severamente fiscalizadas na extração ilegal de madeiras, no seu envolvimento em conflitos pela posse de terra e na sua obrigação em manejar a floresta de modo sustentável.

5. A fim de reduzir os grandes números de acidentes de trabalho é importante prestar mais atenção à prevenção desses acidentes. Isso requer melhores condições de trabalho, melhor orientação aos trabalhadores sobre o uso cauteloso das máquinas e o uso de equipamentos de proteção (botas, luvas e capacete).
6. A região amazônica precisa de um serviço florestal firme e bem organizado, com suficiente pessoal, material e meios financeiros para um desempenho adequado da sua tarefa de fiscalização.
7. Precisa-se de uma fiscalização mais rigorosa e penalidades mais duras para combater a extração ilegal de madeira de áreas de preservação e de reservas indígenas.
8. Pesquisas sobre métodos de extração sustentáveis, adaptados às condições da Amazônia, merecem mais apoio. Além disso, é recomendável prestar mais atenção à divulgação e difusão dos resultados dessas pesquisas no meio de empresários madeireiros e planejadores com poder de decisão.
9. Finalmente, é recomendável estimular iniciativas orientadas para a conservação e/ou utilização sustentável da floresta, por exemplo por meio de incentivos fiscais ou outros incentivos financeiros para a preservação, proteção o ou manejo da floresta.

Curriculum Vitae

The author was born in Utrecht, the Netherlands, on December 26, 1956. She was raised in 's-Hertogenbosch where she received her high school (*Atheneum A*) diploma at the Jeroen Bosch College in 1975. From 1975 to 1984 she studied Human Geography at the Catholic University of Nijmegen. After receiving her Bachelor of Arts Degree in 1979, she specialized in the Human Geography of Developing Areas and gained her Master's Degree in 1984. In 1985 she left for a year in Brazil to research the need for training courses and cultural activities amongst the people living in an Agricultural Colony of Dutch immigrants in the state of São Paulo (Holambra II). She returned to the Netherlands and became engaged in educational and information activities on development issues at the Third World Centre in The Hague. From 1987 to 1992 she worked as a junior researcher in the Department of Human Geography of Developing Areas of Nijmegen University. With financial support from the Netherlands Foundation for the Advancement of Tropical Research (WOTRO), she conducted research and wrote her PhD thesis on the timber industry in the Brazilian Amazon region. Currently, she is engaged as a programme officer at the Tropenbos Foundation in Wageningen where she is in charge of the initiation, promotion and monitoring of research oriented towards the conservation and responsible utilization of tropical rainforests.

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STELLINGEN

I

In het verleden heeft de discussie omtrent de openlegging van het Amazonegebied zich teveel toegespitst op de vraag òf het Amazonegebied ontwikkeld zou moeten worden. Het ware beter geweest als men zich had afgevraagd hòe het Amazonegebied ontwikkeld zou moeten worden. Een goede planning van het landgebruik en zeggenschap van de lokale bevolking daarin zijn essentieel.

II

De stelling van Poelhekke (1984) dat men in het Amazonegebied van gekapt dik hout te weinig planken zaagt kan onder meer worden verklaard doordat men er door (de soortenrijkdom van) het bos de (commercieel interessante) bomen niet meer ziet.
Poelhekke, F.G.M.N. Prikkeldraad in het oerwoud: De veeteelt in het proces van economische en sociale integratie van het Amazonegebied in Brazilië. Nijmegen: Katholieke Universiteit, 1984.

III

Onderzoek naar beheer en duurzame exploitatie van tropisch regenwoud heeft weinig zin als dit niet wordt gecombineerd met sociaal-economisch onderzoek naar de omstandigheden waarin bosbeheer vorm moet krijgen. Daarbij moet onder meer rekening worden gehouden met andere vormen van bosgebruik en functies van het bos, die ruimtelijk onverenigbaar kunnen zijn met houtexploitatie.

IV

De campagnes om de import van tropisch hardhout uit niet duurzaam beheerde bossen te stoppen vervullen een belangrijke rol in de publieke bewustwording van de problematiek van tropische regenwouden. Hun effectiviteit ten aanzien van het bewerkstelligen van duurzaam bosbeheer moet echter sterk worden betwijfeld.

V

Er zijn weinig redenen om te veronderstellen dat betere prijzen voor tropisch hardhout automatisch zullen leiden tot duurzame houtkap in het Amazonegebied.

VI

Gezien de veel grotere bijdrage van het Noorden aan de uitstoot van CO_2 en de verslechterende kwaliteit van bossen in de gematigde streken (Dudley, 1992), lijkt de zorg over het verdwijnen van tropische regenwouden en de gevolgen daarvan voor niet-tropische gebieden soms op het zien van een splinter in het oog van een ander en niet van de balk in het eigen oog.
Dudley, N. Forests in Trouble: A Review of the Status of Temperate Forests Worldwide. Gland: WWF, 1992.

VII

Het is een stuk gemakkelijker om te constateren wat er in het Amazonegebied allemaal fout gaat, dan om daarvoor een oplossing aan te dragen (naar Westoby, 1978).
Westoby, J. Forest Industries for Socio-economic Development. Guest Speaker's Address, Eighth World Forestry Congress, Jakarta, Indonesia, 23 October, 1978.

VIII

De toename van het aantal dissertaties in de Engelse taal moet niet worden toegeschreven aan de groeiende internationalisering, maar aan de drempelverlagende werking die uitgaat van de synoniemenfunctie en spellingscontrole waarmee moderne tekstverwerkingsprogramma's zijn uitgerust.

Stellingen behorend bij het proefschrift
Tropical hardwood from the Brazilian Amazon:
A study of the timber industry in western Pará
van M.A.F. Ros-Tonen
Nijmegen, 15 maart 1993

This book deals with the exploitation, processing and marketing of tropical hardwood in Brazilian Amazonia and with the effects of these activities It has much to add to the current debate on the role of commercial logging in deforestation and development, which has hitherto been based on inadequate information about the situation in the region which is the home of the world's largest reserve of tropical rain forest

The book considers the background to the rapid growth of the Amazonian timber industry which has taken place during the past few decades and the spatial and socio-economic features of the production units and the actors involved It describes the various ways and means of supplying the sawmills with logs and discusses the ecological effects of timber extraction

The prospect of sustainable forest management in the Brazilian Amazon is evaluated Particular attention is given to the benefits and the possible negative impacts of the timber industry on the local people The analysis of the place of Amazonian timber on the international market for tropical hardwood includes an assessment of whether trade measures could influence existing exploitation practices and deforestation figures In the concluding chapter an answer is provided to the question which has run through the entire study, i e could timber exploitation contribute to the sustainable development of the Amazon region?

By considering both the forestry aspects and the wider socio-economic context of the timber industry this book is able to bridge the gap between the different disciplines dealing with forest exploitation and development in the tropics

The 'Nijmeegs Instituut voor Comparatieve Cultuur- en Ontwikkelingsstudies' (NICCOS - Nijmegen Institute for Comparative Studies in Development and Cultural Change) of the Catholic University of Nijmegen, the Netherlands, was established in 1989 in order to co-ordinate and stimulate the research in the Third World and in peripheral regions of the industrialized countries carried out by the Department of Cultural and Social Anthropology, the Department of Geography of Developing Areas, the Third World Centre, the Centre for Women's Studies, the Missiology Department and the Department of Middle East Languages and Cultures